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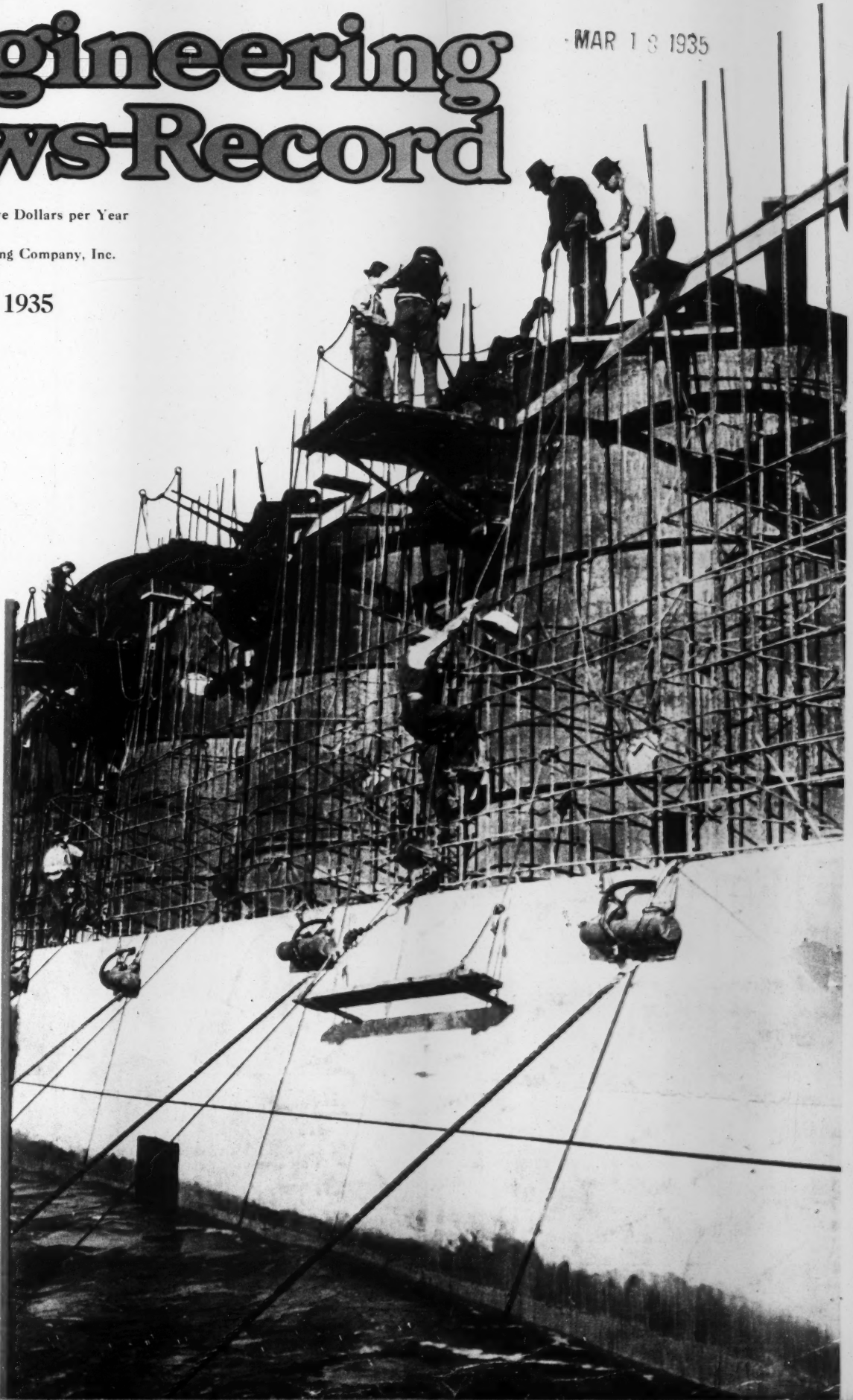

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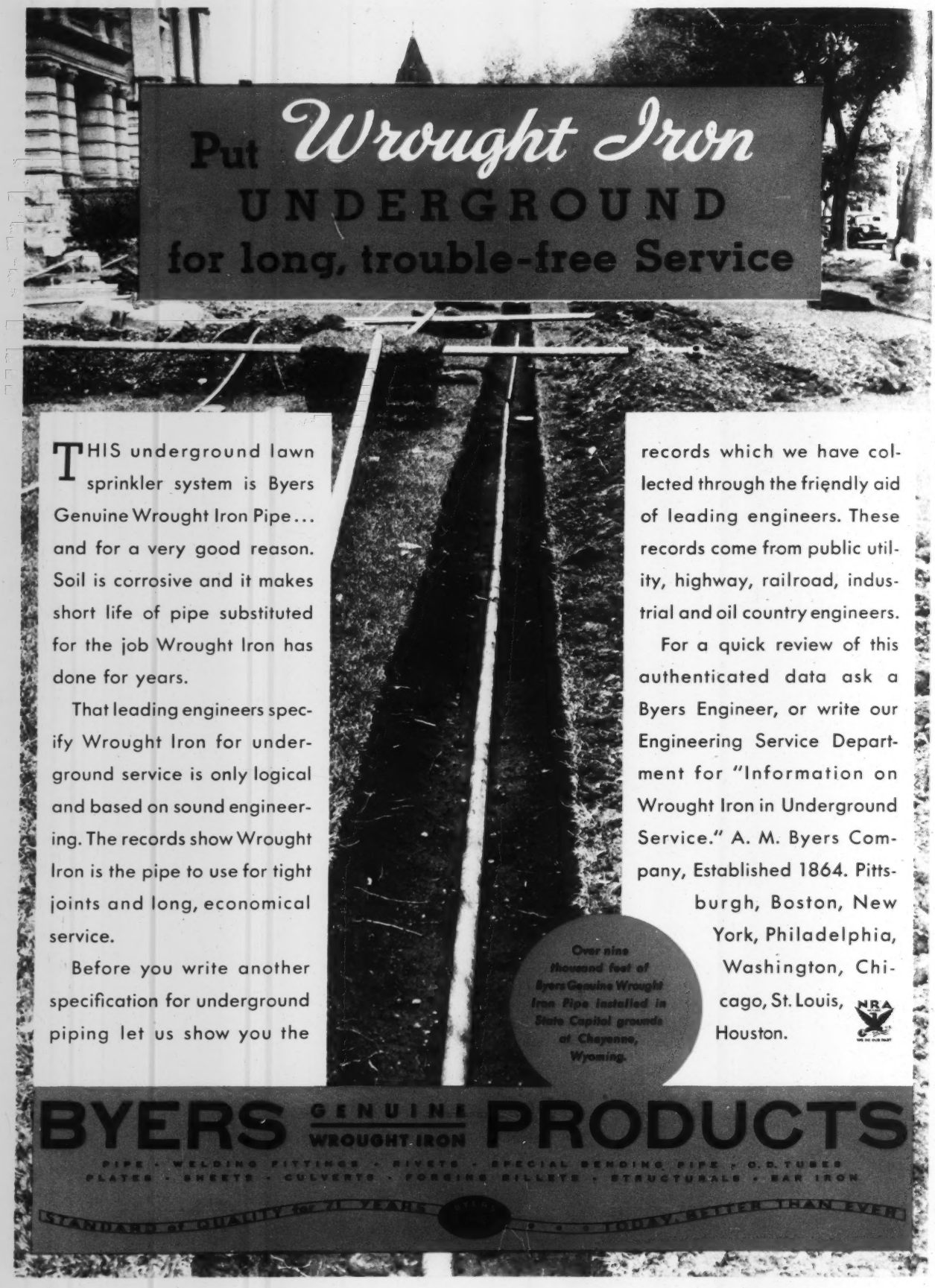
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The Construction Industry and the New Deal

LAST week this page discussed one instance of general failure to understand the construction industry, as revealed by the current controversy over the President's emergency construction program. A second, which also deserves consideration, has to do with peculiar claims of this industry to special consideration by the New Deal.

Few laymen recognize that in the construction industry we have a stronghold of the principle of free competition between independents of small capital. Here we find preserved and developed to the highest degree those distinctive characteristics that we always associate with American enterprise and accomplishment. What is more, this must remain so unless some radical change is imposed upon the structure of the industry.

For construction work is widespread, diversified and must be carried on at the site. The constructor must go to his work; he cannot draw the work to him as is true with most manufacturing industries. Then, too, each separate job usually is for a different owner at a different site, and when the constructor finishes with one he must move on to the next. Moreover, it is prevailing practice to award each such job by open competitive bid of some sort. Thus the number of existing contractors of demonstrated competence is very large and the number of their potential competitors on any job is limited only by the number of ambitious superintendents and foremen that now are looking forward to the day when they can bid in a job on their own.

Likewise with the professional groups. Ambitious and aggressive engineers and architects the country over have forsaken the security of a payroll and gone in for themselves. They have surrounded themselves by staffs that, by virtue of their close association and their competitive need to win and hold clients, achieve high proficiency.

Too often, when the layman thinks of construction, he thinks of an Empire State Building, a Boulder Dam or a Golden Gate Bridge. And he associates physical bigness with industrial bigness. Surely, he thinks, this is Big Business. But he forgets that these huge undertakings are rare and that even they, each in turn, soon must be completed, when the contractor must move on to bid on new work. Big Business, with whatever alleged evils may attach to it, cannot possibly thrive on so spotty and so nomadic an industry, so dependent, moreover, on a high degree of personal competence and responsibility.

The vast bulk of construction does not consist of these exceptional and spectacular jobs; it is in a myriad of small jobs of infinite variety, strewn broadcast over the land in thousands of cities, towns and villages, on the face of the plains and in the canyons of the mountains, ranging from a few hundred dollars in cost into the hundreds of thousands.

All these conditions have created and must maintain in this industry an atmosphere of enterprising individualism, free competition and opportunity for the capable operator with but limited capital. It is not an atmosphere favorable to the growth of monopoly, oppression or financial manipulation. It puts a premium on that productive genius and enterprise upon which our business and industrial progress have been founded.

If the President wants to give that kind of business a break, if his New Deal means increased opportunity for the competent producer, small as well as large, he can look a long time before he will find a more promising field for it than is offered by the construction industry. For as it is organized and has functioned hitherto, it is the happy hunting ground for the free competition of individual enterprise, a veritable stronghold of those basic American business virtues.

It is to be hoped that no reckless or ill-advised turn toward a nationalized construction industry, under the guise of a governmental day-labor system, will be permitted to undermine or destroy it.

Willard Chevalier

ENGINEERING NEWS-RECORD

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The "Depression" is no longer an excuse for old style equipment

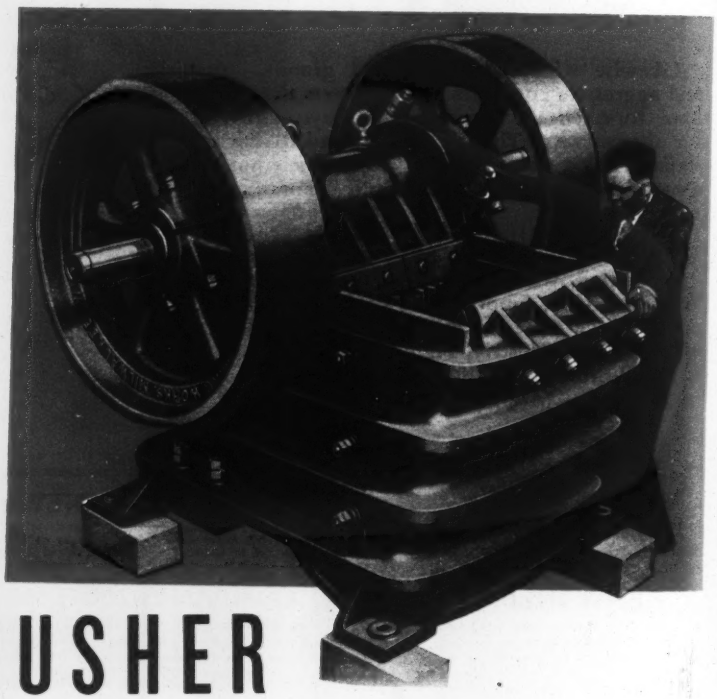
THE depression produced a psychology of price. The use of the now old fashioned plain bearing jaw crusher was based on price rather than value. The roller bearing jaw crusher . . . designed and built for today's needs . . . is the key to profits—in the form of greater speed, larger capacity and lower maintenance.

About one-third of your jaw crusher investment is in the frame and swinging jaw—massive steel castings which cost a lot of money and last indefinitely. In these parts, the investment is about the same whether you buy a crusher with roller bearings or a cheaper outfit. *But*—the roller bearings permit higher crushing speed . . . almost double your capacity . . . without any greater expenditure for power. This is a mighty big dividend on the small additional investment.

There's one other important part in a jaw crusher—the shaft. In the Telsmith roller-bearing machine, all the wear is taken off this big steel forging . . . transferred to the hardened alloy steel races and roller bearings. Except for fatigue, the shaft is as good in its tenth season as when it left the shop. You buy new bearings at long intervals; but your shaft is an almost permanent investment . . . like the big steel castings. Have you figured what this means in terms of lower up-keep?

Add up these items—(a) bigger capacity (b) lower power consumption per-ton-crushed (c) less maintenance expense and (d) a crusher which, in its three important elements, is an almost permanent investment. Is it worth a little more money? We think so and a long list of users agree with us. Write for Bulletin W-2.

W-12



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In the News:

A REVISED PROGRAM for the Casper-Alcova project, reducing the area to be irrigated but leaving the Seminoe power development unaffected, has been approved by Secretary Ickes.

REGULAR PASSENGER-TRAIN SERVICE was started Feb. 10 on the electrified line of the Pennsylvania Railroad between New York and Washington. This track and equipment work constitutes the largest non-federal work project financed by the PWA program.

ARIZONA is using the argument of obstruction to the navigability of the Colorado River as one of the main points in its answer to the government suit to show cause why the work on Parker Dam should continue to be blocked.

A BILLION-DOLLAR PROGRAM of proposed public improvements will be submitted to the PWA by Mayor LaGuardia of New York in response to the general inquiry addressed to cities requesting lists of works projects that are ready for rapid start.

AS A FURTHER PRACTICAL EXPERIMENT in the field of highway lighting, a 1-mile section of two-lane concrete paving has been equipped with sodium-vapor lights at Pompton Lakes, N. J.

CONGRESS has voted $60,000 to carry forward the investigations of the International Boundary Commission, to determine a plan for canalization of the Rio Grande between Caballo Reservoir site and El Paso.

THE NEW BANKING BILL of the Administration would make it possible for Federal Reserve banks to accept real estate paper for rediscount and, as a result, make money for construction much more available.

A PWA ALLOTMENT OF $150,000 has been made for an investigation and report on the proposed trans-mountain diversion project from the upper basin of the Colorado River to the South Platte River drainage basin in Colorado.

ST. LOUIS has received a PWA allotment of $1,103,000 for completing the railroad approaches to the municipal bridge. The $1,400,000 advanced by the Terminal Railroad Association has already been spent on these approaches, which can be completed by the PWA allotment.

In This Issue:

SUCCESSFUL COMPLETION of the deep pier foundations on the San Francisco-Oakland Bridge ranks with the greatest of engineering achievements. The attainment, however, was not without its anxious moments and its troublesome problems. How these problems were met and overcome is the subject of an article in this issue written by the engineers in charge.

THERE IS more than two-thirds of a billion dollars worth of highway and bridge work that can be put under contract within three months, according to a survey made by the American Association of State Highway Officials and reported in this issue.

THE DIVERSION TUNNEL to be used during the building of Alcova Dam in Wyoming has been completed. Construction procedure was complicated by fissured rock containing hot water and gases. Excavating, grouting and lining are described.

LACK OF large-scale maps covering the area subjected to TVA planning was a distinct handicap in the early stages of the work. Neither time nor money for topographic mapping being available, the U. S. Geological Survey utilized planimeter maps made with the aid of aerial photography.

UNIQUE WATER TREATMENT in which both iron and manganese are removed is practiced in a new plant at Lincoln, Neb. Operations include (1) aeration, (2) chlorination, (3) filtering through coke, gravel or manganese ore, (4) sedimentation and (5) rapid sand filtration.

FINENESS MODULUS and surface area as measures of concrete-aggregate gradation are not so sacrosanct as some believe. Colonel F. S. Besson, of the Corps of Engineers, explains why and urges trial mixes as the only rational method.

PUBLIC WORKS POLL

Analysis of the returns on the *Engineering News-Record* survey of reader opinion regarding continuation of the federal public works program is made on page 255.

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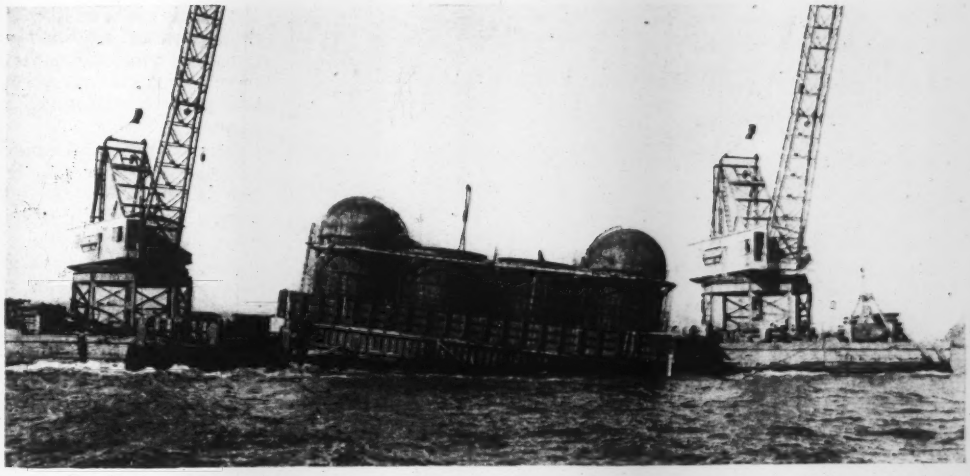


FIG. 1—TIPPING 16 FT. TO THE EAST, as a result of sudden failure of supporting material when the cutting edge was about 25 ft. in the mud, Pier 6 in the West Channel crossing was righted by method described in the article.

Difficult Problems Overcome in Sinking Deep Caissons—I

Difficulties in pier construction for the San Francisco-Oakland Bridge reviewed with outline of precautions taken, incidents experienced and lessons learned—Two methods for deep foundations compared with comments on design and operation

By C. H. Purcell, Chas. E. Andrew and Glenn B. Woodruff

Chief Engineer, Bridge Engineer and Engineer of Design, San Francisco-Oakland Bay Bridge

THE LARGEST and deepest subaqueous foundations ever attempted were finished late last year with the completion of the last pier for the San Francisco-Oakland Bridge. In the two principal divisions of the structure, one from San Francisco to Yerba Buena Island and the other from the island to the East Bay shore, piers were built simultaneously by different contractors using entirely different types of open-dredge caissons. During the critical stages of sinking these caissons, there were several incidents which might have developed into serious difficulties, but the behavior of the caissons demonstrated that the designs were well adapted to the conditions encountered. The entire foundation project has been attended with marked success, which is largely due to the skillful handling of the work by the contractors and the constant engineering supervision.

For the benefit of engineers in carrying out future foundation work, the authors have prepared this article, to place on record the novel phases of experience gained in sinking the San Francisco-Oakland Bridge caissons the precautions which they believe should be observed in such work, and a comparison of the types of caissons used, with some comments on their design.

A review of the project is not possible, and reference is made to previous articles which describe in detail the general phases of the project and the design and general procedure used for the foundations in the west and east channels. These major articles are: a general description of the project, *ENR*, March 22, 1934, p. 371; "West Channel Foundations Built with Unique Domed Caissons," *ENR*, April 5, 1934, p. 431; and "Deep Open Caisson for the East Channel," *ENR*, Aug. 23, 1934, p. 227. The present article will not attempt to review the detailed information given in these preceding articles. Beginning with summation of the important conclusions reached as the result of this foundation work, the article describes in detail the sinking of each major caisson.

Stability of caissons

While a caisson is floating its stability is subject to definite calculation. After the cutting edge enters the mud, the buoyant or supporting forces cannot be definitely analyzed. The material at the bed of the stream may

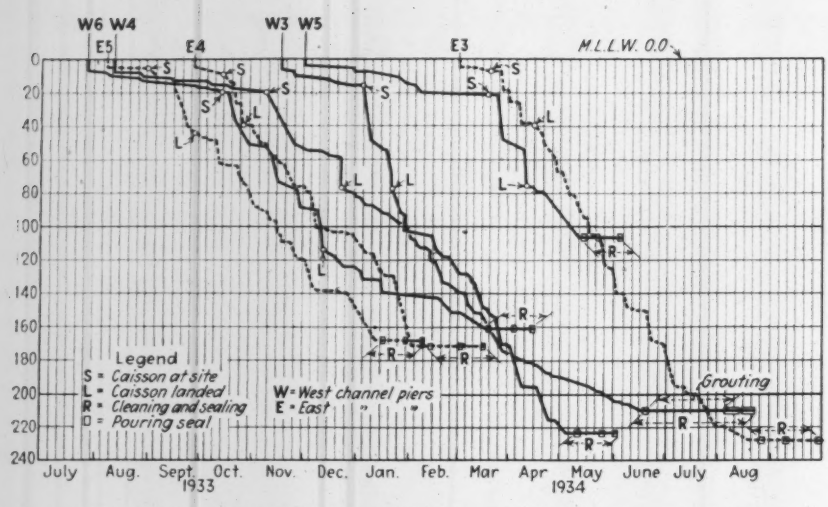


FIG. 2—RATE OF PROGRESS in sinking caissons for both the East Channel and West Channel crossings.

have the properties of a solid, it may act as a fluid of higher specific gravity than water, or it may be anywhere in between, with frequent variations. Disturbance of the material by dredging operations, by superimposed load or even by the lubricating action of water may result in the sudden change from the properties of a solid to those of a fluid. Foundation material generally is not homogeneous over the entire area.

Since the problem is not subject to definite analysis, the design of the caisson and the execution of the work should be such as to minimize the hazards. Experience resulting from foundation work on the San Francisco Bay bridge suggests the following precautions:

1. *Keep the weight of the caisson low and its center of gravity as near the cutting edge as possible.* With the dome caisson (see detailed description in *ENR*, April 5, 1934, p. 436), a comparatively small increase in total cost will make the design such that the surface of the concrete may be kept a considerable distance below the surface of the water outside the caisson at all stages of sinking, at least until the caisson has reached sufficient penetration so there is no possibility of tipping.

With the false-bottom caissons the procedure is to flood all wells before removing false bottoms. The weight of the water adds considerably to the load supported by the mud and may result in lowering the effective center of displacement. It may cause considerable displacement of mud under the cutting edge, which is liable to disturb the equilibrium of the caisson. Under these conditions, side support at a high level is very desirable and may be essential to the stability of the caisson.

2. *Maintain symmetry at the cutting-edge level.* In case soil conditions at the cutting-edge level are uniform, the removal of false bottoms and all dredging operations should be kept absolutely symmetrical. This procedure needs to be altered to allow for non-uniformity of soil conditions, but in such cases provision should be made for rapid operations to restore symmetry.

3. *Avoid sudden movements of material.* Dredging operations should be such as to relieve pressure at the center of the caisson and to maintain rim bearing under the outside edge. If, at any time, the caisson fails to settle as a result of dredging, and the dredging is near the cutting-edge level, dredging should be suspended and the supports cut away with jets. Most caisson accidents have resulted from trying to speed up the work.

4. *Sink opposite ends of the caisson in succession.* In a rectangular caisson, tipping is most probable about the long axis. This probability may be lessened by dredging at the opposite ends of the caisson in succession.

5. *Keep the undercutting of the outside cutting edges to a minimum.* At no time prior to the final cleaning for the seal should the excavation go below the outside cutting edges. Any undercutting may result in an inflow of material with a tendency to tip the caisson. It also loosens the outside material so that the inflow is liable to prove troublesome in the final clean-up preparatory to sealing.

The following description of operations indicates that all troubles or possibilities of trouble resulted from disregard of one or more of the foregoing precautions. In this connection, however, no set of rules can insure success in sinking a caisson. Any caisson is liable to develop perverse tendencies that can be corrected only by common-sense remedies.

Sinking and landing experience

Fig. 2 shows the record of sinking and incidental operations on the four West Bay crossing and the three E[illegible] Bay crossing caissons. (For des[illegible] location, depth and sinking procedu[illegible] see *ENR*, April 5, 1934, p. 436, [illegible] Aug. 23, 1934, p. 233.) The only [illegible] time was during the righting opera[illegible] at W-6 and the sealing of W-4. [illegible] operations on the caissons in the W[illegible] Bay crossing were continuous; on t[illegible] East Bay crossing the work was c[illegible] tinuous except on Sundays. All ope[illegible] tions prior to landing the caissons w[illegible] merely routine of raising cofferda[illegible] and placing reinforcing steel and co[illegible] crete.

The operation of landing West B[illegible] caissons consisted simply of droppi[illegible] the caisson by release of enough [illegible] from the domes to permit the cutti[illegible] edge to penetrate about 8 ft. into t[illegible] mud. The main problem was to o[illegible] tain correct location. Tidal acti[illegible] moved the floating caissons in an orbi[illegible] Prior to landing the caissons, anch[illegible] lines were adjusted so that at slack ti[illegible] the caisson would be vertically over i[illegible] correct position. During landing, rea[illegible] ings on the caisson were taken fro[illegible] triangulation stations and radioed t[illegible] the office, from which directions as t[illegible] hauling on the anchor lines were radioed to the job. The results were so successful that all caissons were landed within 6 in. of correct position.

Landing the East Bay caissons presented an entirely different problem. They were blocked in position from guide frames and pile clusters, so that there was no question of their position at the time the cutting edge entered the mud.

The principal concern here was successful removal of the false bottoms.

These false-bottom caissons were so designed that, during flotation, the surface of the concrete was below water level. The weight necessary for landing them might have been furnished by water or other ballast placed in the dredging wells. The extra depth thus gained would have caused additional head on the outer cofferdam. To avoid this, the contractor elected to secure the necessary weight by adding concrete. Since the rate of weight increase caused by pouring was small when compared to the tidal displacement, the result was that the caissons were landed on a low tide, lifted off by one or two succeeding high tides and landed finally on the fall of the tide. On a foundation subject to scour, this might have been serious; in this case, however, the procedure gave no trouble.

After the cutting edge of E-4 reached the bottom, the underlying mud was subjected to a load of 2 tons per square foot by adding 5,000 tons of concrete and filling the dredging wells with 5,500 tons of water. As a result, the caisson sank 16 ft. into the mud, displacing more than 3,000 cu.yd. of material, which formed a 4-ft. mud wave outside the caisson. During this sinking and during the removal of the false bottoms, the top of the caisson rocked 3 ft. in each

direction. This movement ceased after the removal of the bottoms.

Similar conditions occurred in the landing of E-3. In this case there was the complication that material at the northwest corner of the caisson was considerably softer than the average. This gave the caisson a tendency to list diagonally and to skew in the same direction. This tendency was checked by piling mud outside the caisson at this corner. The caisson was leveled by dredging outside on the east side. Removing material at this point reduced the resistance to mud flowing out under the east cutting edge.

Tipping of caisson W-6

Caisson W-6 was landed on mud bottom Dec. 11, 1933, with the cutting edge at El. —114.6. Concreting was resumed immediately, and by the 19th it had been carried to 120 ft. above the cutting edge. Air pressure on the domes was removed on the 22d, and water was pumped into the cylinders as air was released. During these operations the cutting edge sank 10 ft. A small amount of dredging was done on the 19th with eleven domes removed. From the 26th to the 31st, concrete was raised to El. 138.5 above the cutting edge. Dredging was resumed on Jan. 3, with the cutting edge at El. —128.7. The engineer's notes for the day state: "Caisson is moved laterally at the top, with relatively small changes in dredging procedure."

Between Jan. 4 and 8, cylinders, forms and reinforcing steel were raised to 165 ft. above the cutting edge. Between Jan. 9 and 14, concrete was raised from El. 138.5 to El. 148.5, an additional weight of 3,400 tons which caused no settlement of the caisson. Dredging was resumed on the 14th, and the caisson sank quite rapidly on the west side, the material evidently being softer on that side. To correct this tendency, the dredging was carried ahead on the east side; the condition at

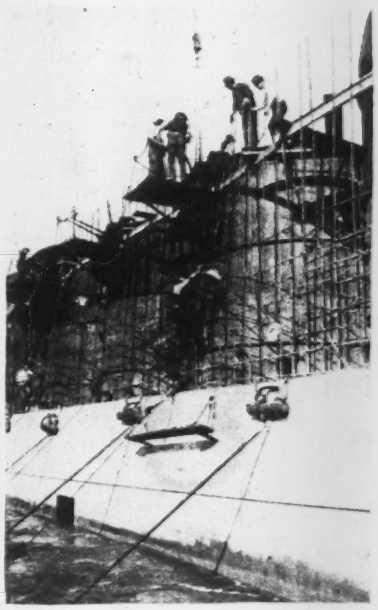


FIG. 3—ANCHOR LINES were temporarily attached to the top of the tilted caisson to assist in righting.

6:10 p.m. is shown by Fig. 4(a). At this time the top of the caisson moved rapidly 16 ft. to the east, lowering the east cutting edge about 8 ft., leaving the caisson in the position shown by Fig. 4(b). In tipping the caisson fell against the floating fender, which aided in preventing further movement.

The reason for the tipping was the sudden failure of the material under the east cutting edge and cross-walls. Sufficient attention had not been given to changes in strata. At El. —119 the formation changed from mud to a stiff clay. At El. —128, the material consisted of a laminated clay and sand, almost a shale. In its undisturbed state it was capable of carrying very heavy loads. The combination of heavy loading, loss of side support caused by dredging and the softening effect of water entering the sand seams caused the material to fail suddenly. The caisson had very little side support from the material that it had penetrated.

As a result of this experience, under similar conditions the engineers would require the following precautions:

1. That the center of gravity of the caisson be kept lower by keeping the top of the concrete not less than 20 ft. below water surface.

2. That lateral support be provided for the caisson at as high a level as practicable.

3. That the dredging be confined to one end of the caisson, and was not to be carried below the cutting-edge level in exterior wells nor to more than 5 ft. below cutting-edge level in interior wells.

4. In case the caisson failed to follow the permitted dredging, that the support under the cross-walls be removed by jetting.

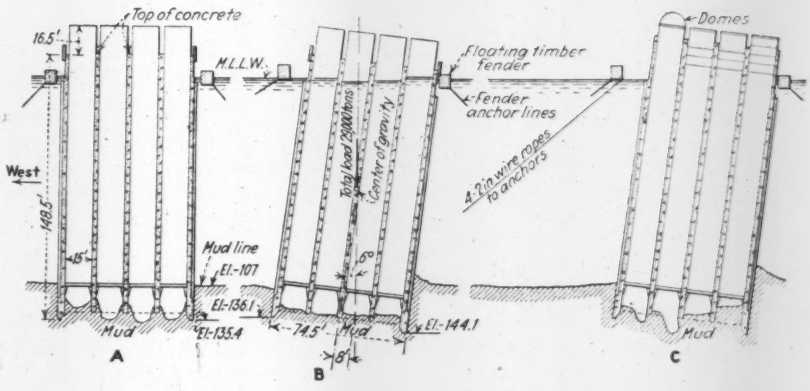
Correcting the tilt

To straighten up the caisson, it was necessary to remove material on the west side. The removal of this material by buckets proved difficult since the buckets caught under the edges of the cross-walls. A "spider" placed on the lead line, to hold the buckets in the center of the cylinders, did not prove effective. Four lines, leading westward to concrete anchors, were attached at the top of the caisson. To insure that the caisson, when righting, would not move too far, four domes were welded on the cylinders in the west row so that compression of entrapped air as the caisson straightened would tend to give a braking effect. The removal of the material under the west cutting edge and the interior cross-walls was accomplished by jetting. The first righting movement of the caisson occurred on Feb. 8, and on the 12th the list had reduced to 3 ft.

In order that future operations might be carried on with the center of gravity as low as possible, a cofferdam was built at the top of the caisson. Since there would have been a delay in obtaining the steel struts and wales to extend a timber cofferdam, the method followed was to add concrete in the outer walls only. On the 12th this concrete cofferdam was built to El. 153.5 above the cutting edge. Although the east cutting edge was still 3 ft. low, dredging was started on that side so as to equalize the mud elevations in all cylinders. On the 15th, the concrete cofferdam was carried to El. 158.5, and water in the cylinders was pumped down to El. —12.0. Dredging was resumed on the east side on the 18th, and the caisson came within 1 ft. of level on the 20th.

The material at the cutting-edge level was very hard. Material could be excavated at the center of the dredging wells, but would not flow laterally sideways from under the cross-walls until

FIG. 4—DIAGRAM OF CAISSON W-6 in normal position and after taking an abrupt tilt (see Fig. 1). The right-hand figure (C) indicates the domes in position and excavation to assist in righting. Before the righting movement started, material under the west cross-walls and cutting edge was removed by jetting. The caisson is 74½x127 ft. in plan, and the maximum tilt was 6 deg.



excavation had been carried some distance below them. To minimize danger of tipping, dredging was carried down to cutting-edge level, and material below the cross-walls was removed by jetting. The procedure of carrying down one end of the caisson at a time also was adopted.

The concrete cofferdam was carried to 163.5 ft. above the cutting edge (Feb. 20), and dredging was started at the south end of the caisson. The south cutting edge was carried 2.5 ft. below the level of the opposite end, and on the 21st the operation was reversed. On that date the north end dropped suddenly to El. —150.0, and two days later to El. —153.3, giving a list of nearly 5 ft. to the north. About 1 ft. of the list was regained by dredging and jetting at the south end. From the 26th to the 28th the interior walls were raised to El. 163.5 and dredging at the south end was resumed. The caisson leveled with the cutting edge at El. —153 [illegible] March 3. On this date, concrete w[illegible] raised to El. 168.5.

* * *

Part II, which will appear in the ne[illegible] issue, will carry forward this descripti[illegible] of caisson work to include not only th[illegible] other three West Channel piers but al[illegible] the false-bottom caissons used in the Ea[illegible] Channel, together with general opinion[illegible] on design comparisons. —EDITOR.

Roadwork Ready for Contract Totals $692,000,000

Survey shows almost seventeen hundred million dollars of required highway improvements that can be put under construction within twelve months

NEEDED highway construction that can be quickly put under contract amounts to nearly $692,000,000 according to reports made by state highway departments to the Association of State Highway Officials. Additional construction amounting to over $1,000,000,000, it is reported, can be put under construction within one year. The reported total, in exact figures, is $1,699,021,300, to be spent on 23,192 projects.

The projects include railway grade-crossing elimination, elimination of congested and dangerous highway intersections, construction and reconstruction of main rural roads, construction and reconstruction of bypasses around and trunk-line roads through cities, and rebuilding of weak and narrow road bridges. The accompanying table gives by states the number of projects of each class and their estimated costs for the 9,467 projects ready for *immediate* construction.

In this table is listed only work on federal-aid and state-road systems. County and township roads are not included.

Pennsylvania leads the list with $61,350,000; New York is second with $51,700,000; and Ohio is third with a total of $45,400,000.

IMPROVEMENTS OF STATE HIGHWAY SYSTEMS THAT CAN BE PUT UNDER CONSTRUCTION IMMEDIATELY

State	R.R. Grade-Crossings		Highway Intersections		Construction of Highways		Construction of Routes Through Cities and City Bypasses		Weak and Narrow Bridges		Grand Total	
	No.	Cost	No.	Cost	No.	Cost	No.	Cost	No.	Cost	No.	Cost
Alabama	48	$1,800,0000	...	.....	39	$11,200,000	16	$1,000,000	40	$4,000,000	143	$18,000,000
Arizona	6	730,000	...	.....	44	7,661,000	7	258,500	9	416,000	66	9,065,500
Arkansas	40	2,500,000	...	.....	40	7,500,000	10	1,000,000	60	1,500,000	150	12,500,000
California	150	24,678,000	4	$1,100,000	115	6,000,000	11	2,000,000	130	2,600,000	410	36,378,000
Colorado	17	2,305,000	...	.....	327	10,000,000	20	700,000	16	825,000	380	13,830,000
Connecticut	19	2,025,000	9	1,600,000	7	1,629,000	7	1,550,000	17	4,485,000	59	11,289,000
Delaware	5	730,000	...	.....	6	500,000	...	.....	3	100,000	14	1,330,000
Florida	32	3,750,000	...	.....	41	3,000,000	4	500,000	16	3,820,000	93	11,070,000
Georgia	60	2,500,000	1	100,000	52	3,000,000	4	700,000	10	2,000,000	127	8,300,000
Idaho	11	800,000	...	.....	38	2,177,000	1	50,000	12	550,000	62	3,577,000
Illinois	75	8,000,000	9	900,000	166	7,500,000	40	5,600,000	30	2,000,000	319	24,000,000
Indiana	2	350,000	...	.....	65	6,429,310	16	341,500	100	1,059,000	183	8,179,810
Iowa	50	4,000,000	10	4,000,000	50	5,000,000	10	500,000	75	3,000,000	195	12,900,000
Kansas	50	3,500,000	2	250,000	25	5,000,000	...	.....	25	1,500,000	102	10,250,000
Kentucky	8	520,000	...	.....	35	5,000,000	10	500,000	8	640,000	61	6,600,000
Louisiana	16	2,200,000	2	150,000	60	4,000,000	1	300,000	12	970,000	91	7,620,000
Maine	22	1,939,500	...	.....	104	3,200,000	1	115,000	40	1,225,000	167	6,479,500
Maryland	22	3,570,000	...	.....	43	1,500,000	13	6,000,000	23	1,650,000	101	12,720,000
Massachusetts	54	6,230,000	7	1,060,000	90	8,000,000	...	.....	*	*	151	15,290,000
Michigan	23	5,025,000	1	250,000	107	6,495,000	9	870,000	15	688,000	155	13,328,000
Minnesota	40	3,000,000	4	400,000	90	13,000,000	15	3,000,000	160	2,000,000	309	21,400,000
Mississippi	33	2,500,000	...	.....	50	8,000,000	...	.....	22	1,500,000	105	12,000,000
Missouri	40	3,309,500	7	535,000	308	8,517,000	10	750,000	60	600,000	425	13,711,500
Montana	18	1,725,000	...	.....	60	5,000,000	...	.....	4	500,000	82	7,225,000
Nebraska	16	620,000	...	.....	170	6,300,000	...	.....	30	450,000	216	7,370,000
Nevada	9	710,000	...	.....	277	1,100,000	...	.....	5	132,500	291	1,942,500
New Hampshire	17	745,000	...	.....	19	1,185,000	2	400,000	17	1,082,000	55	3,412,000
New Jersey	43	11,367,000	16	2,400,000	6	4,000,000	6	4,000,000	2	500,000	73	21,767,000
New Mexico	9	485,000	...	.....	30	2,500,000	2	250,000	26	500,000	67	3,735,000
New York	129	16,000,000	36	4,000,000	120	20,000,000	30	6,000,000	138	5,700,000	453	51,700,000
North Carolina	28	1,268,000	1	50,000	100	4,000,000	60	1,000,000	47	2,366,000	236	8,684,000
North Dakota	15	600,000	...	.....	40	2,000,000	20	600,000	20	250,000	95	3,450,000
Ohio	150	25,000,000	...	.....	343	10,700,000	18	3,700,000	175	6,000,000	686	45,400,000
Oklahoma	34	1,995,000	...	.....	24	4,255,000	...	.....	39	5,664,000	97	11,914,000
Oregon	20	2,500,000	1	250,000	10	4,000,000	7	1,500,000	20	750,000	58	9,000,000
Pennsylvania	73	8,000,000	2	550,000	530	36,300,000	100	10,000,000	303	6,500,000	1,008	61,350,000
Rhode Island	5	415,000	3	425,000	30	2,000,000	...	.....	3	115,000	41	2,955,000
South Carolina	30	700,000	4	300,000	75	10,000,000	20	5,000,000	100	1,000,000	229	17,000,000
South Dakota	31	790,000	5	175,000	150	3,600,000	8	200,000	176	1,875,000	370	6,640,000
Tennessee	17	840,000	1	40,000	149	25,700,000	1	500,000	87	1,950,000	255	29,030,000
Texas	25	1,700,000	6	450,000	200	12,000,000	50	1,500,000	9	960,000	290	16,610,000
Utah	28	2,635,000	1	80,000	75	2,260,000	1	120,000	16	640,000	121	5,735,000
Vermont	32	2,125,000	...	.....	30	1,745,000	2	175,000	35	1,489,000	99	5,534,000
Virginia	43	1,845,000	5	200,000	65	6,000,000	4	500,000	41	1,683,000	158	10,228,000
Washington	44	3,627,000	1	75,000	65	6,200,000	30	1,100,000	20	1,400,000	160	12,402,000
West Virginia	24	2,935,000	20	250,000	50	5,000,000	5	250,000	23	2,807,500	122	11,242,500
Wisconsin	87	9,225,000	3	650,000	100	20,000,000	50	10,000,000	58	4,715,000	298	44,590,000
Wyoming	6	500,000	...	.....	25	2,000,000	...	.....	8	300,000	39	2,800,000
Total	1,756	$184,314,000	161	$20,240,000	4,645	$332,153,310	621	$72,530,000	2,285	$86,457,000	9,467	$691,534,310

*In roads.

Preparing New Maps of the Tennessee River Basin

Inadequate existing maps hinder TVA work of planning—Planimetric maps made on 1 in.-2,000 ft. scale—Serial photography and rapid drafting are features

By T. P. Pendleton
United States Geological Survey, Washington, D. C.

TOPOGRAPHIC map work in the Tennessee River Basin was started by the Geological Survey in 1882. The early maps, in view of the state of the art, answered the needs of their time, but they are deficient in many respects and of little value at present. In recent years a small area was mapped on a larger scale, which may be considered satisfactory, but large areas in the west end of the valley have never been topographically mapped on any scale. This situation well illustrates the wisdom of a carefully considered and comprehensive plan for mapping the United States, with a sufficient and regular allotment of funds to carry the plan to completion in a reasonably short time.

The existing maps of the Tennessee River Basin are on two scales: the older ones have a scale equivalent to 1 in. = 2 miles, and the more recent ones have been drawn to the scale of 1 in. = 1 mile. These small map scales and the complete lack of maps in a large part of the basin have seriously handicapped the Tennessee Valley Authority in its preliminary studies. The planning for the development and control of the water resources of the valley, control of soil erosion, utilization of land, selection of new highway locations, and reforestation could not be properly accomplished without the help of good maps. One of the first acts of the Authority was to arrange to correct this condition, and the Geological Survey, in cooperation with the Authority, is now mapping the basin by modern methods on a uniform scale much larger than that of the existing maps. The new series of maps will be drawn in accordance with standards of accuracy considered appropriate for the scale adopted.

Selection of scale

The most useful scale for mapping an area where so many needs must be satisfied would be one that would best serve the requirements of the most detailed study to be undertaken by the Tennessee Valley Authority. This scale would be much larger than is usually employed in mapping areas as extensive as the Tennessee Basin and would require so long a time for completion that a compromise was effected. A scale of 1 in. = 2,000 ft. was adopted. This is larger than scales usually employed for maps of large areas, yet not so large that completion of the mapping will be materially retarded. To cover the area on this scale, 766 maps will be made.

A topographic map is more desirable than maps of other types, but considerations of cost and time required for completion made it advisable to defer consideration of this type in the emergency. A map of the planimetric type, which shows all features and information appearing on the topographic map except the contour lines, was selected as the best substitute. This type of map can be constructed with considerable speed by utilizing aerial photography, and it will serve as a base map for all general studies to be made by the Authority. In the event that topographic mapping is needed in special areas, contour lines will be drawn on the planimetric map as a base. This phase of the work will be more quickly accomplished than usual, as the topographer will be concerned only with the delineation of the contour lines and will be relieved of all work involving the location of cultural and drainage features.

Aerial photography used

The single-lens aerial camera is not the most economical to use in mapping large areas where closely spaced triangulation stations are required for control and the angular field of view is so small that many closely spaced parallel flights are needed to photograph the area completely. As a result, a camera of the multi-lens type was selected, whose field of view embraces about 140 deg. This large field of view is obtained by combining five single-lens cameras to form a camera of five chambers, with all the shutters functioning simultaneously. Four of these cameras are inclined outward 43 deg. from the axis of the fifth chamber, which points directly downward. As the four inclined cameras are disposed on the four sides of the central camera, a view is obtained far to each side, forward and backward. The five photographs are combined to form a composite photograph equivalent to one that would be supplied by a wide-angle lens having a field of view of 140 deg.

When operating at an altitude sufficient to yield a scale of 1 in. = 2,000 ft., this camera records a view some 12 miles wide and 84 square miles in area. Obviously the ability to cover so large an area by one composite photograph makes for economy of flying. The photography of this area of 40,600 square miles was accomplished in eight months and involved the exposure and development of 50,000 negatives. This large number of photographs was made necessary by the overlap of adjacent views and by the type of camera used, which, as stated, makes five negatives at each exposure.

The physical character of the basin varies considerably. The lower end is of slight relief, but the upper tributary streams have sources in the highest mountains of the eastern United States. Much of the area is heavily wooded, and in general the valley surface is so irregular that some of the advantages usually accruing from the use of aerial photographs were entirely unattainable. These conditions were carefully considered in devising the compilation method to be used with the aerial photographs.

Triangulation is used to control the mapping in the sparsely settled, heavily wooded and mountainous areas, but in more favorable regions the transit traverse is more advantageous. This work is performed by the Geological Survey and is tied to first-order triangulation of the United States Coast and Geodetic Survey. Triangulation to be used as control for aerial photographs involves considerably more work than is essential with other forms of control, as definite ties must be made between the triangulation stations and identifiable points in the photographs. These points must be objects which are clearly and definitely distinguishable on the aerial photographs and which can therefore be used in lieu of the triangulation stations to control the radial intersections. Topographic conditions in wooded mountainous regions may make it impossible to place the control points where they are needed, and in many of the photographs there is a scarcity of suitable definite objects to which the triangulation points can be referred. In regions of lower relief, where transit traverse is more suitable as control, the necessary ties to definite objects can usually be obtained without great difficulty, for road intersections, fence corners, and other clearly defined features are available in abundance.

Compilation of maps

The compilation of the planimetric maps of the Tennessee Basin involves methods somewhat different from those usually employed. The principal influences that have acted to modify the methods are the great relief of the east end of the basin, the rolling surface elsewhere, the urgent need for the maps, and the lack of a large group of men skilled in map work of this type. To meet these requirements, it was decided to alter the usual procedure by training each draftsman to become acquainted

with some one individual operation in the process, so that he could soon contribute in a material way to the map compilation.

To reduce the confusion resulting from simultaneous compilation of the cultural, drainage and woodland features, these phases of the work are performed as independent operations. The compiler who is engaged in working up the cultural features confines himself to the proper delineation of the roads, houses, railroads and transmission lines and is not concerned with other details. This part of the compilation is then inked by other draftsmen skilled in topographic-map inking, and the map is returned for compilation of the drainage features. These in turn receive the attention of other draftsmen, who locate the rivers and smaller streams and the principal divides. When these details have been inked, another compiler locates the woodland outlines, and they in turn are inked. Owing to the irregularity of the terrain, it is necessary to locate all details by numerous intersections, to insure the desired accuracy; hundreds of such points are required on each small map sheet.

To complete maps of this type, it is necessary to visit the areas that they represent, in order to obtain place names and locate the civil boundary lines. During these visits the map is examined, and errors due to faulty interpretation of the photographic details are corrected. With increased experience of the compilers, the number of such necessary changes should gradually decrease until the time consumed in this work becomes unimportant.

On completion of the field examination, the necessary additions and alterations recommended by the inspector are made, and the map is ready for lettering. This will be done by printing on thin paper from type the names that are to appear in the body of the map as well as in the margin. These names will be cut out and pasted in position. Uniformity of lettering throughout the 766 maps of the project will thus be attained.

Illinois Engineers Celebrate Fiftieth Anniversary

Meeting endorses registration bills for engineers and surveyors and reviews PWA projects and state highway program — Water and sewage-treatment subjects prominent

THE SPONSORING of a long-projected Illinois engineers' registration law was one of the important features of the fiftieth annual convention of the Illinois Society of Engineers, held at East St. Louis, Ill., Jan. 31 to Feb. 2. In six sessions of a three day meeting the society gave attention to matters of public relations and succeeded in giving proportionate time to each of its eight sections, although papers on water supply and sewage disposal were the most numerous.

Society membership at 394 showed an increase of 70 during 1934. Officers for the year are: Prof. G. W. Pickels, University of Illinois, president; Paul E. Green, consulting engineer, Chicago, vice-president; H. E. Babbitt, Urbana, secretary. A certificate of honorary membership was presented to E. E. R. Tratman, an active member for 37 years, a past-president, and secretary for 21 years. The meeting in 1936 will be held at Urbana to commemorate the founding of the society in January, 1885.

Registration law

A committee was appointed to carry to the state legislature the proposed civil engineers' registration bill, which is similar to the one endorsed by the society and introduced in 1933 but left stranded by the adjournment of the legislature. The bill is based upon the existing law for the registration of structural engineers, which it would replace, the term "structural engineer" being changed to "civil engineer" throughout the bill. It provides that those already holding the structural certificate would receive the new civil certificate. The committee is directed to confer with representatives of other interested societies and has power to make certain desired changes which will not affect the purport of the law. The society further recommended that the examining board of the Illinois Department of Education and Registration should cooperate with the National Council of State Boards of Engineering Examiners, to secure the advantages of reciprocal exchange of information.

In discussing this subject, A. M. Kaindl, a Chicago member of the legislature, referred to the fact that 28 states now have engineers' registration laws, and that Illinois engineers are at a disadvantage since they cannot work in such states, while registered engineers from those states can practice in Illinois. One difficulty seems to have been lack of support, or even divided support of rival bills. He referred also to a separate bill for the registration of land surveyors, which has been introduced and has the endorsement of the Illinois Society of Engineers.

An urgent plea for active support of the National Society of Professional Engineers was made by D. B. Steinman, president of that society. The Illinois Society of Engineers is already affiliated with it, but Mr. Steinman pleaded for active individual support in order that the national society might unquestionably represent the profession as a whole in dealing with matters of legislation, employment and remuneration, which directly affect the profession and the individual engineer. The activities of the American Engineering Council for the aid of the engineer in the present depression and unemployment situation were reviewed by F. M. Feiker, executive secretary of the council.

Water supply and treatment

Of 510 applications made by Illinois communities to the Public Works Administration for federal aid, 245 were approved at Washington, with an estimated cost of $69,382,000, as explained by C. M. Osborn, state engineer for the PWA. Of 144 projects for which contracts have been let, 68 are under construction, 31 completed and others in preparatory stages. Out of 245 projects, 40 per cent are waterworks, 22 per cent schools and 18 per cent sewers, indicating that the first come nearest to meeting the PWA requirements.

Of the 97 water-supply projects, serving 539,200 population, and estimated to cost $4,750,000 for materials, 41 are for new systems and 56 are improvements and extensions. Of the new projects, which serve an average of 1,200 persons each, 34 will obtain a supply from wells and seven from surface waters. Their total cost is estimated at $2,806,500, an average of $68,400 each, or $57 per capita.

As to the average cost of $57 per capita, W. D. Gerber, engineer of the Illinois state water survey, stated in discussion that $35 per capita has been used by engineers as representing the economic desirability of a waterworks installation. More than half the population of the state depends upon Lake Michigan for its water supply. Wells are becoming less satisfactory in both quantity and quality of supply. In the gravel zone of the central part of the state the gravel and sand beds are not continuous, so that exploration is needed to locate the beds or pockets and determine their waterbearing properties.

A paper on mineral qualities of domestic water supply was presented by C. W. Klassen, acting chief engineer, and J. G. Weart, chemist, of the Illinois department of health. In Illinois 78 per cent of the population in municipal-

ities has waters averaging 181 p.p.m. in minerals, but a large proportion of this population is served from Lake Michigan, whose water has 130 p.p.m., is low in iron and has no corrosive properties. Other communities use groundwaters averaging 331 p.p.m. in hardness and surface waters averaging 180, but in both of these waters the iron content is generally above the desirable limit.

Municipal water softening

The operating methods and chemical aspects of water-softening by lime, soda ash and zeolite were described in a paper on municipal softening plants by H. B. Crane, International Filter Co. In discussion, it was shown by Warren A. Kramer, senior chemist, St. Louis water department, that in such plants lime is generally added to the water before the soda ash, although in small plants and in hot processes the two are mixed before being added to the water. Of the various coagulants, choice can be determined only by experiment with the water to be treated; Denver is the only important city that has used sodium aluminate to any extent. Iron salts have become popular in recent years.

Operating records from the three municipal water-softening plants at Western Springs and Hinsdale, Ill., and Benton Harbor, Mich., were presented by Carl Leipold, superintendent of the filtration plant at Winnetka, Ill. In view of the variable results in flocculation with different coagulants under different conditions, it was suggested by W. R. Gelston, Jr., of Quincy, Ill., that mixing basins should be designed for flexibility in speed of mixing, so as to permit of determining what type of mix will give the best results. He preferred paddle mixers to baffled mixing chambers.

Dry feeders, in his opinion, are preferable if the chemicals have particles of absolutely uniform size, but the modern tendency to bulk storage intensifies the problem of segregation of particles. At Quincy there is sometimes 100 per cent variation in rate of feed at one setting of a good volumetric machine feeding a good quality of alum. As to sludge, if not discharged into a river, it may be used to fill low ground or given away as fertilizer. At the Quincy plant the average alkalinity and hardness of the raw water are 151 and 165 p.p.m., while for the filtered water they are 42.5 and 77 p.p.m., respectively.

Aeration of sewage

In a comparison of air diffusion and mechanical agitation for aerating sewage, Prof. H. E. Babbitt, University of Illinois, stated that the former is used in the majority of plants in spite of its numerous disadvantages, such as the large amount of equipment, the amount of labor to operate and maintain the equipment, and the difficulties due to clogging of the diffuser devices.

Against these objections may be placed the relatively simple mechanism of mechanical aerators, which require less power, are almost foolproof, run for long periods without attention, and can be maintained by unskilled labor. These devices are of three classes: paddle, aspirator and combined paddle and aspirator. There is less return sludge with mechanical aeration, but the reason is not yet apparent. On the other hand, certain types of agitators require relatively shallow tanks, thus necessitating larger surface areas, which in some cases might be an objection in relation to increased size of site. Relatively small plants furnish a specially suitable field for mechanical aeration, because of the simplicity and reliability of operation.

At Michigan City, Ind., on account of limited funds, one mixing basin and one settling basin were used instead of the usual pairs of basins, but flexibility was obtained by additional piping, which provided for reversal of flow in the settling basin. For the new water plant at Hammond, Ind., however, the larger size and the greater liability of polluted water rendered the provisions for hydraulic flexibility of greater importance.

Operating-cost records for five years at the sprinkling-filter sewage-treatment works at Bloomington, Ill., were reviewed by H. E. Wilson, superintendent. The plant serves 40,000 in a population of 55,000, and its pumping averages 4½ m.g.d. Cost records of operating and extra labor are kept by daily time reports and monthly cost totals. These time reports are itemized as to the several parts of the plant, so that they show where the time has been spent. For the five-year period, the average monthly cost has been $284, with a range from $191 to $405. Adding $2,600 for the superintendent and $1,104 for a part-time chemist, the annual operating cost has averaged $10,724.

Two operating difficulties encountered in the activated-sludge sewage plant at Geneva, Ill., were noted in a paper by E. Roy Wells, Geneva. The velocity of sludge in 6-in. pipes was found to be too low, causing excessive pumping of return sludge. After experimenting with liners to reduce the diameter of the pipes, 4-in. liners were placed permanently and have eliminated the trouble. The gas-fired boiler failed to carry the heating load of the digestor, and the cause was found to be an excessive supply of secondary air to the burners.

Highways and taxes

That the motorists should give critical attention to the roadbuilding program, in order that the money spent may yield the maximum in road service, was urged by Prof. C. C. Wiley, University of Illinois. The state legislature in 1931 created a Commission on Future Road Program, and nearly all its major recommendations made in 1933 have been adopted as policies or enacted into law. Thus Illinois has a basic road program suitable for a long term of years. But there are indications of breaks in this program, which would be disastrous.

Of the $18,000,000 in annual state license fees, half is required for interest on the road bonds and another extensive allotment for maintenance, leaving $5,000,000 for extensions and betterments. With the motor fee reduced to $3, which has been proposed, the total income would be only $5,000,000, or not enough even to meet bond interest. But the law provides that any such deficiency must be met by a property tax, which in this case would amount to $4,000,000. At the same time there would be no state funds for maintenance or extension. With the present low motor fee and gas tax in Illinois, he considered it unreasonable thus to check and hamper the road program.

There is much talk of high-speed roads, but Professor Wiley considered that with present speeds of 45 m.p.h., roads need not be designed for more than 60 m.p.h. For that speed, however, curves should not be less than about 2,000-ft. radius, while grade changes should have longer vertical curves to give better sight distances. Belt lines and bypass roads should not be built until traffic surveys have been made.

Low-cost gravel and slag construction for surfacing or base course for secondary roads was described by F. Burggraffe, of the Calcium Chloride Association. In this so-called "stabilized" system, the graded materials are proportioned to produce a mixture resisting lateral flow under load, while the necessary moisture content is maintained by a chemical that absorbs moisture from the air and also reduces evaporation.

That the drought of 1933-34 really began with a departure from normal rainfall in 1930 was stressed by W. G. Potter, chief of the bureau of rivers and lakes, Illinois division of waterways. From Jan. 1, 1930, to Aug. 1, 1934, the rainfall was 17.56 in. below normal, and from Nov. 1, 1933, to June 1, 1934, it was only 47.1 per cent of normal (57.8 per cent in the southern section of the state). At the same time high temperatures increased the evaporation, and groundwater levels dropped below the field drains. In the same 1930-1934 period, river discharges decreased about 51 per cent, and Lake Michigan declined to its lowest level, El. 577.7. He predicted that unless there is much more than normal rain and snow this winter and spring, the drought may extend over still another season.

The Mississippi River dam at Alton, Ill., was the subject of an address by Capt. W. W. Wanamaker, U. S. Corps of Engineers, and a small party visited the work at the lock.

Manganese and Iron-Removal Plant for Lincoln, Neb.

Appearance of manganese in Nebraska waters renders new well supply unusable—Chemists find way to eliminate difficulty at reasonable cost—New removal plant ultimately to provide softening

MANGANESE in objectionable quantities (above 0.1 p.p.m.) in the new Platte Valley well-water supply of Lincoln, Neb., made its occurrence known in a most spectacular manner fourteen months after the new supply had been turned into the mains. Overnight the tap water became turbid, having the appearance of diluted black ink. Investigation revealed a 6-in. sludge deposit in all the reservoirs and a gelatinous coating on the inside of the 25-mile, 36-in. pipe, brownish red at the Ashland end and black at the Lincoln end (*ENR*, April 20, 1933, p. 487). Luckily, the city had sufficient capacity for its immediate needs in the old wells within the city. After thorough cleaning of the reservoirs and flushing of the 36-in. pipe, it has been possible to use the Ashland supply by systematic flushing every three weeks.

D. L. Erickson, city engineer of Lincoln, recently outlined to the Missouri Valley Section of the American Water Works Association the procedure following in ferreting out the trouble, diagnosing the cause and carrying out the prescriptions of chemists and consulting engineers. From his remarks and a subsequent visit of a representative of *ENR* to the Ashland site, where elaborate research is still under way and a manganese and iron-removal plant is under construction, the following notes are presented.

Chemists found that the manganese content of the water from the five wells varied from 0.25 to 1.25 p.p.m., and the iron content varied from 0.3 to 0.6 p.p.m. The wells closest to the river, Nos. 3, 4 and 5, contained the least amount of manganese. Upstream analyses showed that wells at Wann and Columbus, Neb., contained 0.8 and 0.6 p.p.m. of manganese, respectively. Grand Island well water contained only a trace. At Grand Island the Loup River joins the Platte. The water of the Loup had 0.1 p.p.m. and that of the Platte 0.05 p.p.m. Thus, it is evident that both rivers flow over manganese bearing soils.

Manganese, like iron, is taken up by water devoid of oxygen but containing CO_2. Change in groundwater level, due possibly to the drought or to the variation in drawdown at the wells, is considered as a possible contributing cause of the incidence of the manganese in the river and the wells. All those who studied the situation agreed that it was unlikely that this fluctuation, if it was the cause, could be remedied, and that treatment of the water was the only solution. Having spent $2,300,000 for the Ashland supply, an additional 50 per cent for a removal plant was obviously advisable so as to conserve the original investment, especially since the wells in Lincoln had started to "salt up," as noted in the previous article.

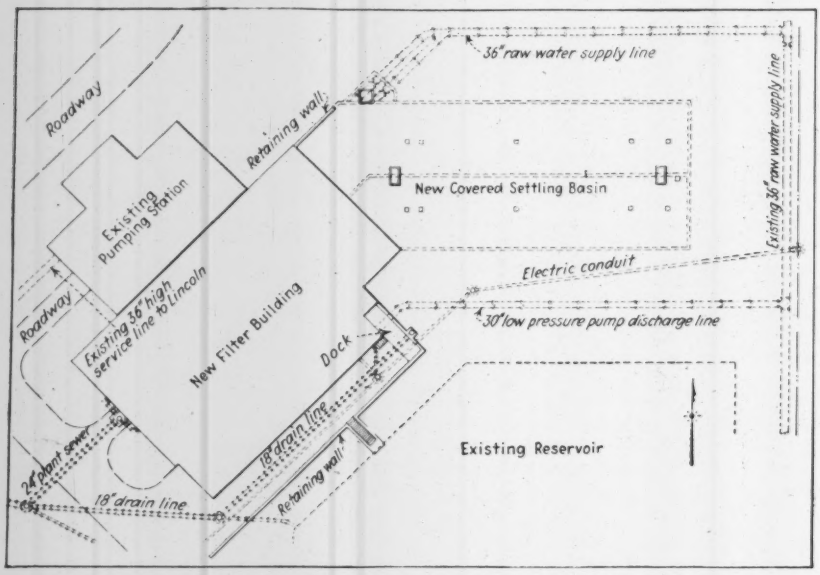


FIG. 1—MANGANESE-REMOVAL PLANT will be built adjacent to existing pumping station. The settling basin will facilitate the adoption of softening treatment in the future.

Manganese-removal experiments

Experiments were conducted at Ashland, primarily to seek the cheapest method of manganese removal, but there was also kept in mind the likelihood that ultimately the consumers would demand softening. The hardness of the well water was between 110 and 210 p.p.m. in October, 1933.

From the experimental manganese-removal systems, which provided for aeration, sedimentation, contact filters and rapid-sand filters, the following conclusions were reached:

1. Rates of aeration as high as 40 gal. per sq. ft. per min. secured satisfactory CO_2 removal and as high as 90 per cent saturation of oxygen absorption.

2. Contact filters containing pyrolusite (manganese ore) gave satisfactory manganese removal at first, but after a period of 30 days the efficiency began to decrease rapidly. At the end of 60 days they were not effective at all. The particles of pyrolusite apparently became coated with a brownish gelatinous material that seemed to interfere with the process. It was found to be possible to clean the pyrolusite and restore the filter to its former efficiency by washing with a 5-per cent solution of either sulphuric acid or hydrochloric acid.

3. In seeking means of cleaning the pyrolusite filter, it was discovered that its efficiency could be restored by the application of 1 p.p.m. of chlorine, immediately after aeration. This was only effective for a few days. Later it developed that satisfactory results could be secured by chlorinating ahead of the contact filters that contained gravel or coke.

4. The use of coke in the contact filters gave about the same results as gravel.

5. There was no apparent benefit derived from the sedimentation basin, when prechlorination was used.

6. A filtering rate of 4 gal. per sq.ft. per minute in the final sand filters was entirely satisfactory.

7. Satisfactory iron and manganese removal could be secured by the addition of 2.5 gr. of lime per gallon, followed by two hours of sedimentation and final sand filtration.

8. Satisfactory iron and manganese

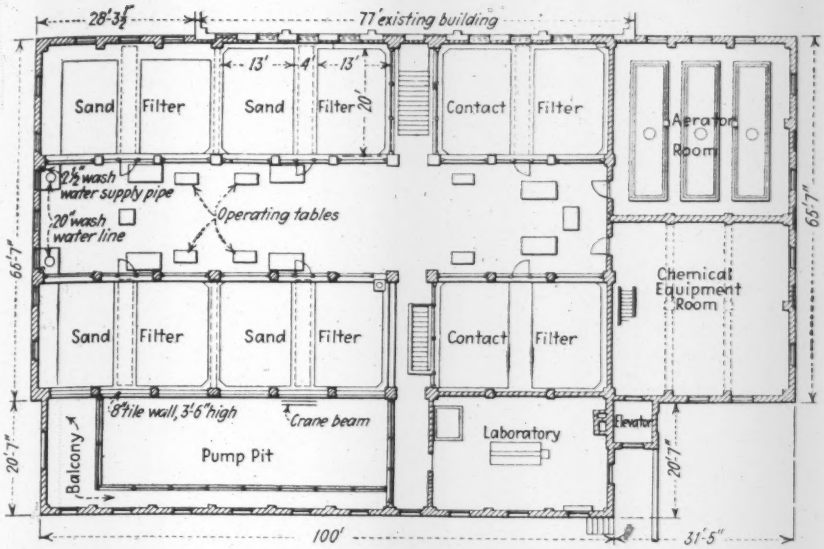


FIG. 2—PROCESSES will comprise aeration, contact filtration and sand filtration. The contact filters will be filled with manganese ore. Flow through them will be upward.

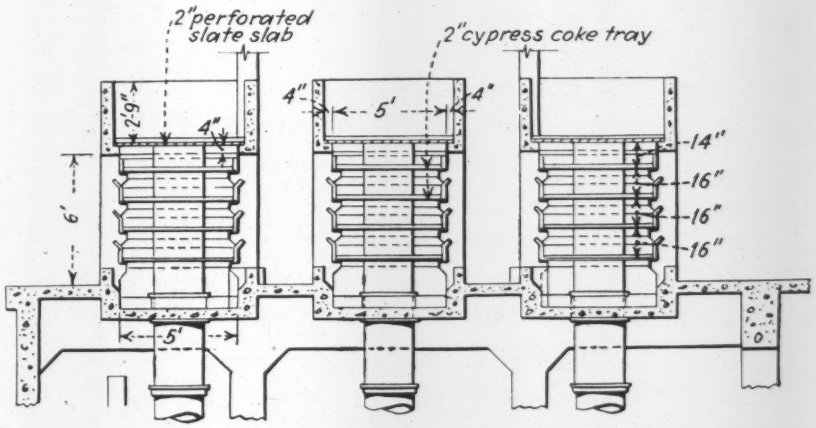


FIG. 3—AERATORS will each consist of four beds of coke supported by cypress trays. Flow will be distributed by slabs of perforated slate. Each unit will be 23 ft. 6 in. long.

removal could be obtained by the following steps: (a) aeration, (b) chlorination (from 0.5 to 1.0 p.p.m.), (c) upward-flow contact filters, containing either coke, gravel or pyrolusite, (d) two-hour sedimentation, (e) rapid sand filtration.

These processes have been incorporated in the design of a new iron and manganese-removal plant. While the experimental plant indicated that better results were possible without sedimentation, a two-hour basin is to be provided for future water-softening processes and as an additional safeguard for the present operation.

The aerator design is similar to that used at Memphis, Tenn., and consists of three units of four trays each, with a 24-in. riser pipe in the center of each unit. The tray bottoms are made of 2-in. slate, drilled with 1 1/16-in. holes spaced on 6-in. centers. Four inches of coke will be placed in each tray. The aerator is designed to operate at the rate of 28 gal. per sq.ft. per min. at 12 m.g.d., or 42 gal. per sq.ft. per min. at 18 m.g.d.

The two contact filters are to be of the upward-flow type, operating at the rate of 8 gal. per sq.ft. per min. With the exception of the direction of flow and the filter media, the contact filters are of the same general construction as the final sand filters, so that whenever it is desired to go to complete water softening, the two contact filters can be converted into standard final sand filters by lowering the washwater troughs and making some minor piping changes to reverse the direction of flow. Provision is made for backwashing as in standard sand filters.

The filter material in the contact filters is to be either pyrolusite, coke or gravel. The decision on this point is being deferred, pending more definite results from the experimental filter plant, which is to be kept in operation during the construction of the plant.

The sedimentation basin will have a capacity of 1 m.g. It will be a rectangular, covered reinforced-concrete basin, divided into two parts by a central wall. The water will enter through a baffle wall and pass slowly through the length of one-half of the basin and back to the plant, passing over a weir at the outlet end.

The final filters are of the rapid-sand type, comprising four units. Each unit will have a capacity of 3 m.g.d., operating at a rate of 4 gal. per sq.ft. per min.

A clear well of 100,000-gal. capacity is to be provided beneath two of the final sand filters. Two electrically driven centrifugal pumping units will be provided, one 7½ m.g.d. and one 11 m.g.d., which will pump the filtered water from the clear well to the existing 3-m.g. reservoir.

With the exception of the sedimentation basin, the entire new plant will be housed in a fireproof stone-faced structure, to adjoin the existing pumping station. Contracts for the entire plant have been awarded at a total cost of about $211,000, and the plant is now under construction with the expectation that it will be completed by May 15, 1935.

John R. Baylis, chemist, Chicago, made the original analysis disclosing the manganese in 1933. The plans and specifications for the iron and manganese-removal plant were prepared by Black and Veatch, consulting engineers, and the plant is being constructed under the direct supervision of D. L. Erickson, city engineer. All work is under the general supervision of Paul W. Doerr, superintendent of the Lincoln water and light department.

Cover Perforation Effective in Manhole Ventilation

Ventilation of manholes by using covers provided with diagonal or conical recessed holes has proved highly effective in aiding the removal of deleterious gases, according to a survey by the U. S. Bureau of Mines and the Boston Edison Co. Exhaustive tests indicate that the number of air changes per day is almost directly proportional to the area of the openings, and that less than 1/30 of the gas concentration found in a manhole without cover openings occurred with a 74.1-cu.ft. experimental manhole having 48 ¾-in. openings. By increasing the wind velocity from still-air conditions to 7 to 10 miles per hour, the ventilation rate was increased from 39 to 121 per cent. The conical-type hole was commended on account of the tendency to prevent the accumulation of dirt and rock in the apertures.

The Case Against Surface Area and Fineness Modulus

Arbitrary weighting of particle sizes gives no exact measurement of cements and concrete aggregates

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IN YEARS PAST there have been several methods of aggregate classification, including the surface area and fineness-modulus methods, advocated as substitutes for the straight mechanical analysis (which pictures the granulometric composition of an aggregate) in attempts to obtain a method adapted directly to the solution of engineering problems. But both the fineness-modulus method and the surface-area method are unsuitable modifications of the straight mechanical analysis. Fineness modulus arbitrarily gives undue weight to the larger particles making up an aggregate, while, on the other hand, the surface-area method gives exaggerated weight to the finer particles. The fineness-modulus method ignores the finest of all. These methods do not give true pictures of the material analyzed. Why complicate matters by using inept modifications when the simple basic analysis does give a true picture?

That the surface-area and fineness-modulus methods cannot be exact measures of the worth of engineering products fabricated from aggregates may be shown as follows:

For an aggregate whose mechanical analysis is as shown in Fig. 1, the surface-area factor is 8,294, which factor is obtained by weighting the percentage of aggregate passing each sieve and retained on the next smaller, in accordance with a geometrical progression. The surface-area factor, 8,294, may represent innumerable granulometric frequency distributions, as indicated by Fig. 2, where it represents aggregate No. 1, which is adaptable to a variety of uses, and also aggregate No. 2, with 70.4 per cent retained on the No. 48 sieve and 29.6 per cent retained on the No. 100, which aggregate is adaptable to very restricted use.

For the aggregate whose mechanical analysis is as shown in Fig. 1, the fineness-modulus number is 2.79, which number is obtained by weighting the percentage retained on each sieve in accordance with an arithmetical progression. The fineness-modulus number 2.79 may also represent innumerable granulometric frequency distributions as indicated by Fig. 3, where it represents aggregate No. 1, as well as aggregate No. 2 with 34.9 per cent retained on the ¾ sieve and all the rest of the material passing the No. 100 sieve.

Surface area was brought prominently to the fore by L. N. Edwards in 1918 by his article in the A.S.T.M. *Proceedings*, in which, for concrete, he presented the idea of proportioning the cement in relation to the surface area of the aggregate. Today, surface-area requirements are being included in some cement-fineness specifications as a measure of cement quality. However, the significance of the fines in aggregate for concrete is opposite to the significance of the fines in cement. And yet the method does not weight the particles in any logical manner, so that it may be stated that the value of an aggregate for concrete varies as an inverse function of the surface area, while the value of a cement varies as a direct function.

If it is assumed that the cumulative plot curves of all cements are similar in shape, then it might be satisfactory to designate cement fineness by a single factor instead of by a complete cumulative plot. In that event it might be satisfactory, instead of computing an arbitrary surface-area factor, simply to determine the cement flour, that is the

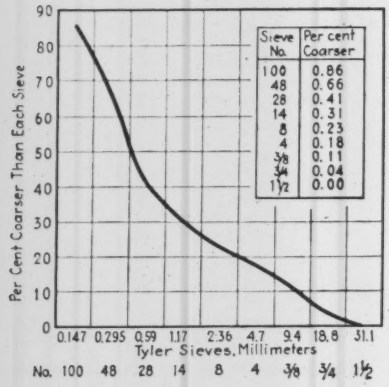


FIG. 1—MECHANICAL ANALYSIS and cumulative plot of an aggregate with a fineness modulus of 2.79 and a surface-area factor of 8,294.

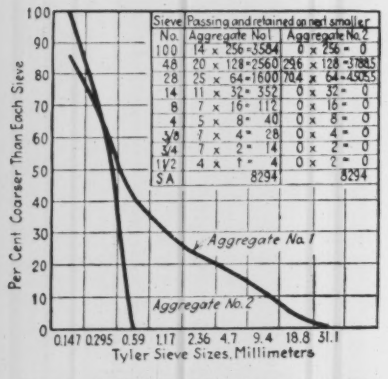


Fig. 2—SURFACE-AREA factor of 8,294 may represent innumerable aggregates.

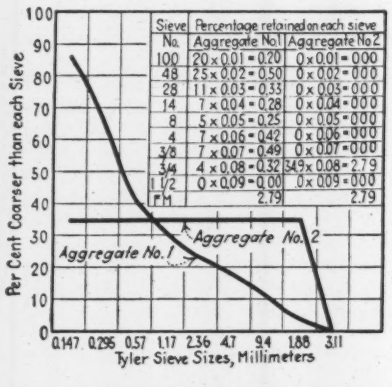


FIG. 3—FINENESS MODULUS of 2.79 may represent innumerable aggregates.

COMPARISON OF MIXES AT PEAKS OF CURVES (FIG. 4) WHICH ARE THE BEST MIXES FOR EACH SAND-GRAVEL COMBINATION.

Aggregate	Mix at Peak of Curve	Compressive Strength Lb. Per Sq. In.
3-in. gravel plus No. 4 sand	1 cement 1.33 sand 2.66 gravel	3,975
3-in. gravel plus No. 30 sand	1 cement 0.92 sand 3.08 gravel	3,600
½-in. gravel plus No. 4 sand	1 cement 1.9 sand 2.1 gravel	2,650
½-in. gravel plus No. 30 sand	1 cement 1.33 sand 2.66 gravel	2,275

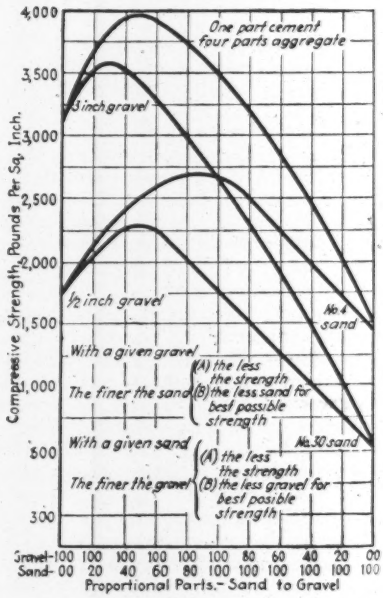

Compressive Strength, Pounds Per Sq. Inch.
Proportional Parts.- Sand to Gravel
Gravel-100 100 100 100 100 100 80 60 40 20 00
Sand- 00 20 40 60 80 100 100 100 100 100 100
One part cement four parts aggregate
3 inch gravel
½ inch gravel
No. 4 sand
With a given gravel
The finer the sand
(A) the less the strength
(B) the less sand for best possible strength
With a given sand
The finer the gravel
(A) the less the strength
(B) the less gravel for best possible strength
No. 30 sand
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
300

FIG. 4—TRIAL-MIX strength curves. Each curve represents a different combination of sand and gravel. Consistency of all mixes was same, and each utilized 1 part cement to 4 parts aggregate.

percentage of cement particles from 0 to 20 microns in diameter.

Fineness modulus dates back to Duff A. Abrams' 1919 report, contained in Bulletin No. 1, Structural Materials Research Laboratory, Lewis Institute. This report states that two aggregates having the same fineness modulus will require the same quantity of water, to produce a mix of the same plasticity, and will give concrete of the same strength, so long as the aggregates are not too coarse for the quantity of cement.

Fineness modulus is an attempt to measure the extent to which gradation and the coarser particles in an aggregate affect concrete strength. A satisfactory way to accomplish this task is to analyze the aggregates under investigation in the following manner:

Take a succession of mixes, one mix being, for example, one part of cement to four parts combined aggregate. Assume that four materials are to be investigated, two being gravel and two sand. Each of the gravels may be combined in various proportions with each of the sands and, making concrete of fixed consistency, four curves will result like those shown in Fig. 4. These curves may be analyzed as follows:

(*a*) The highest curve (maximum strength) represents combinations of coarse gravel and coarse sand.

(*b*) The lowest curve (minimum strength) represents combinations of fine gravel and fine sand.

(*c*) The gravel has more influence upon strength than the sand. With either sand, when the coarse gravel is used, a strength of more than 3,500 lb. may be obtained, while with the fine gravel, even when using the favorable coarse sand, only a strength about 1,000 lb. below 3,500 can be reached.

(*d*) Substituting coarse sand for fine moves the peak of the strength curve toward larger proportions of sand; and substituting fine gravel for coarse also moves the peak toward larger proportions of sand. Thus maximum proportions of sand are called for by fine gravel and coarse sand mixtures; and maximum proportions of gravel, by coarse gravel and fine sand mixtures.

(*e*) Mixes represented by the peaks of the curves are the best proportions for each of the four combined aggregates, as shown in the accompanying table.

An analysis such as that presented by Fig. 4 shows the exact influence of gradation and the importance of the coarser particles. These results cannot be presented by the surface-area and fineness-modulus methods, which weigh the particles in accordance with arbitrary assumptions.

A Decade of Development in the Oxy-Acetylene Processes

ADVANCES in welding and cutting with oxy-acetylene were reviewed at the last meeting of the International Acetylene Association in a paper by G. O. Carter, chairman of the association's oxy-acetylene committee and consulting engineer of the Linde Air Products Co. The development during the past decade, he said, has been more extensive and rapid than anyone at the beginning of the period would have dared predict. For example, in the pipe-welding field in 1924, standards of productivity called for four to five joints per day on 16- and 18-in. pipe; now it is expected that each welder should produce from 20 to 25 joints per day on 18- and 20-in. pipe and as many as 60 or 70 joints per day on 6-in. pipe. Furthermore, to accomplish this much greater output, the torches do not use appreciably more oxygen and acetylene per hour of operation than was required ten years ago. The welds are somewhat narrower, but today at least three times as much metal is deposited for the same quantity of gas in the flame as was done in 1924.

Present-day equipment is unquestionably more rugged and gives a flame that is satisfactorily steady under all operating conditions. In the equipment line there has been the development of double-stage regulators, of blowpipes and torches practically free from backfiring, and in certain lines of activities the equipment permits the use of flames many times larger than the maximum possible only a few years ago.

Mr. Carter stated that there is a growing disposition on the part of men in the structural field to doubt the advantage of the fillet weld as compared with the butt weld. It was the committee's opinion that once the superiority of the butt-type weld over the fillet-type weld is recognized, the opportunity for use of oxy-acetylene welding in structural work will improve.

Ten years ago it was quite unusual to include in an estimate any items other than the welder's wages and the cost of oxygen and acetylene; the welding rod, which was then of Norway iron costing about 7c. per lb., was considered to be such a small part of the total that it could be left out of the calculation. With the development of high-grade welding rods, reduction in cost of gas and improvement in the efficiency of applying the flame, the welding rod has now become the most expensive element. Inasmuch as the welding rod for ordinary steel has increased in value by approximately 100 per cent, it is obvious that there has been a remarkable decrease in the other costs. Even in the item of labor there has been a marked relative decrease due to the much more rapid application of the weld metal. Bronze welding rods and rods for use in hard surfacing are developments of recent years. At the beginning of the decade a cast-iron repair job was invariably made with cast-iron welding rod. Bronze-welding is today the standard method of making repairs to cast iron, and in contrast to cast-iron rod welding the operation of bronze-welding can be carried on without dismantling the machinery and generally with only a moderate amount of preheat, which can be supplied by the welding flame itself.

Improvement in the oxy-acetylene cutting process has gone hand in hand with welding improvements. Where heavy cross-sections or alloy steels even in light cross-section are to be flame-cut, the base metal is heated in furnaces. This cutting of steel at a dull red temperature has resulted in the elimination of certain of the troubles encountered due to the too rapid cooling of the cut surfaces. The reheating of the material to a normalizing temperature is also a constructive help in putting it in better shape than would have been the case if the material had been cold-machined without any subsequent heat treatment.

In the field of cutting, important modern operations are flame-machining, steel-billet surfacing, tap-hole burning and oxygen lance-cutting.

Surveyors' Status Changed by Law in California

Licensed land surveyors in California on June 30 last numbered 2,146. On the following day the number was only 643. Yet in this overnight change the number of persons authorized to make land surveys increased from 2,146 to more than 5,000. The explanation of this riddle is that a law passed by the 1933 legislature in California repealed the 1907 law providing for the licensing of land suveyors and cancelled all licenses issued under the old law which were not renewed before July 1, 1934. Only 643 renewed. The increase in the number of persons authorized to practice land surveying in the state results from a clause in the 1933 law which provides that registered civil engineers also may practice land surveying.

Diversion and Outlet Tunnel for Casper-Alcova Dam

Tunnel driven through limestone carrying hot water and gas—Grouting checked inflow and produced tight lining

FIG. 1—OUTLET PORTAL of diversion tunnel at Alcova Dam and channel showing hydraulic jump shoulder. View was taken looking downstream toward town of Alcova.

CONSTRUCTION on the Casper-Alcova irrigation and hydro-electric project on the North Platte River in Wyoming was begun in 1933, shortly after allotment for the work had been made by the Public Works Administration. This quick action to get men employed was possible because the river-diversion tunnel around one flank of the dam and the headworks tunnels, siphons and a part of the distribution canal could be put under contract independently of the final design and construction of the dam. A glance at the accompanying sketch map (Fig. 3) will make this possibility clear. Four contracts were let, one for the diversion tunnel, one for each of the two headworks tunnels and one for the siphons and the canal excavation.

A general description of the Casper-Alcova project was published in *Engineering News-Record*, Aug. 31, 1933, p. 251, and an economic survey appeared in the issue of Nov. 29, 1934, p. 698. Since that time work has been suspended pending a decision on certain general policies. Meanwhile the diversion tunnel had been completed and two-thirds of the work under contract had been accomplished.

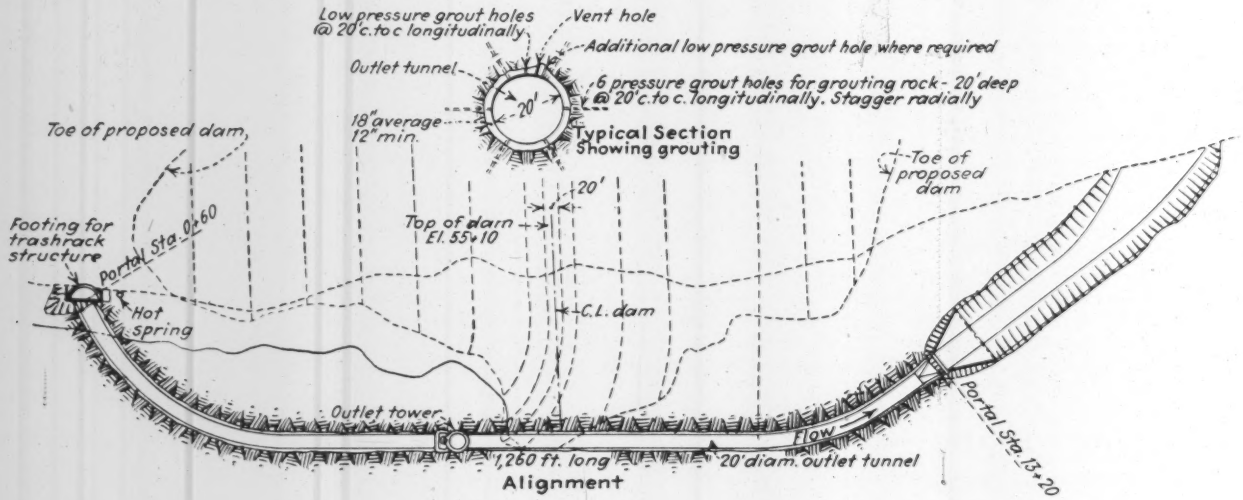
On Feb. 6 the Secretary of the Interior announced that he had approved a revised plan for the project calling for construction of the main canal far enough to irrigate 35,000 acres but with a capacity for 66,000 acres whenever this might be required.

Tunnel structure

Construction of the diversion tunnel was interesting chiefly for the methods employed to overcome inflows of hot water and gas and for some of the excavating and lining operations. The plan and section (Fig. 2) indicate the principal structural details and dimensions. As the tunnel was designed to be the outlet after being used for river diversion, it was provided with a shaft and control valves, as shown by Fig. 4.

Control of water passing through the tunnel, as called for in the design, is to be by two 84-in. needle valves in a 43x33½-ft. chamber 68½ ft. high at the base of an outlet shaft 183½ ft. deep, having a 12x16-ft. elevator shaft and a 6x8-ft. air shaft alongside. The 20-ft. circular tunnel is to be closed 26 ft. ahead of the control chamber by a plug of concrete, in the center of which are the pipes leading to the valves. An elliptical transition section, 33 ft. from side to side, returns to the 20-ft. circle in a distance of 50 ft. The inlet transition is short, formed in concrete, to the ends of the bell mouths of the 8-ft. pipe. Adjacent to the elevator shaft is a pump chamber connected with a conduit leading out under the full length of the dam. Numerous grout pipes are to start from this conduit, to be ready in case leakage should later develop through the strata under the dam. They could be

FIG. 2—DIVERSION and outlet tunnel for the Alcova Dam cuts through sandstone and a limestone bearing hot water and gas.



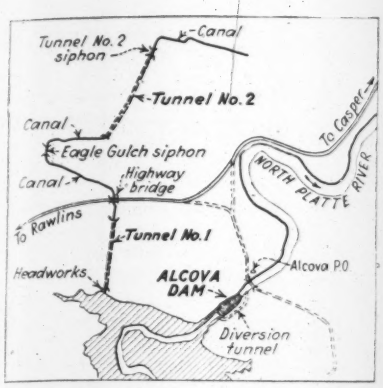


FIG. 3—MAP OF CASPER-ALCOVA project, showing diversion tunnel and headworks tunnels and siphons.

drilled out to deeper levels and further grouting carried on, ingress being obtained through the pump chamber via the elevator shaft.

Excavating the tunnel

Except for the trash racks and control-chamber equipment, the diversion tunnel was completed last October. It passes through massive bedded sandstone of the Tensleep formation and porous limestone of the Amsden formation with an incline of about 5 deg. upstream. The latter formation is fissured, and at the upstream end the outcrop carries streams of hot mineralized water with a temperature of 132 deg. Hydrogen gas also escapes. Thus the tunnel workers were subjected to tunnel temperatures of 92 deg. and high humidities. To make it unnecessary for them to stand in the hot water, the bottom 3 ft. of the tunnel was not mucked out until the flow was stopped by grouting. Both temperature and humidity were reduced after the heading connection was made and all ventilation problems were solved. The early section at the downstream end was in sandstone and did not carry such high temperatures and hot water as occurred after getting into the fissured limestone farther upstream.

Although there was some discomfort to the laborers from the heat and humidity, not a man was injured, and the work progressed rapidly.

Incidentally, the hot water of the mineral springs has for years been considered medicinal. Remnants of an old bathhouse exist, and on the hill above the dam site a promoter laid out a resort town whose streets can still be traced as clearings in the sagebrush. Analyses indicate no sulphates and little calcium and magnesium but much pure hydrogen gas.

A drain was provided in the center of the bottom bench, which served as a roadway for an air-driven shovel with a sawed-off boom, 6 ft. long, which was used as a mucker to load trucks.

The tunnel was driven without timbering, and the lower bench was prosecuted entirely from the lower end. About one-quarter of the upper section of the heading was first taken out and the muck removed by wheelbarrows over the bench that was being shot. The muck was loaded by a shovel some 30 ft. back of the face. Muck considered suitable was placed for the down-stream toe of the dam. Holes usually were driven 15 ft.; a non-gaseous powder was used.

Grouting around the tunnel

In excavating the tunnel, several prominent bedding planes were encountered, from the seams of which issued hot-water springs of various temperatures and sizes. After the main excavation of the tunnel had been completed and before the concrete lining was placed, grouting was done to cut off the flows of water into the tunnel. Some 175 holes were drilled, 4 to 20 ft. deep and totaling 1,751 ft., and 3,248 cu.ft. of grout was injected at 40 to 100 lb. pressure, using a mixture of 1 part cement to 1 part sand, the latter gradually decreasing as the hole filled. The amount of grout per hole varied from 1 to 2,000 cu.ft. This grouting operation cut off about 90 per cent of the inflowing hot water.

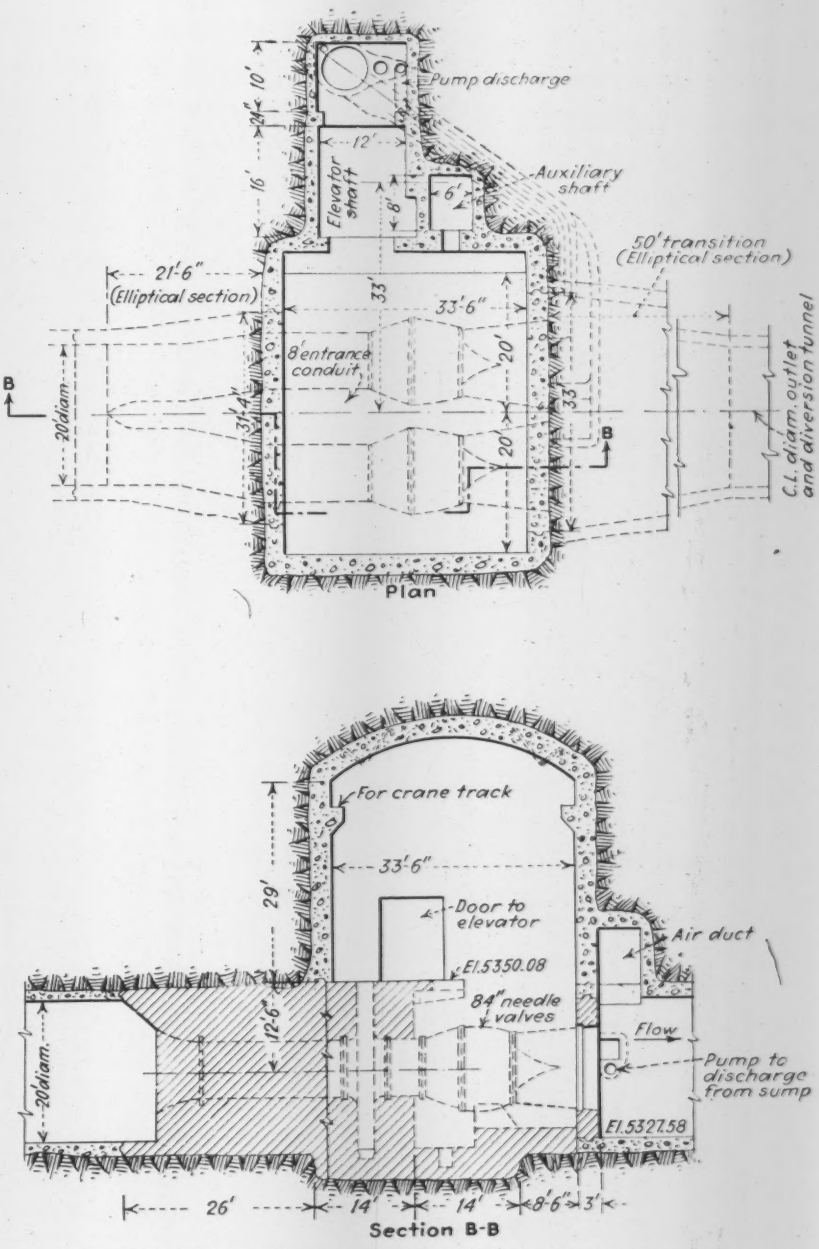


FIG. 4—VALVE CHAMBER and elevator shaft, air shaft to ground level and beginning of shaft to drainage tunnel under dam.

During the concrete lining, grout pipes were inserted in the arch section of the tunnel at 20-ft. intervals longitudinally throughout the entire length of the tunnel. Through these pipes, grout was injected at 100-lb. pressure, to fill all cavities in the adjacent rock and to take care of the concrete shrinkage.

In this operation, 5,396 cu.ft. of grout was placed. Inspection early in November, 1934, shortly after all the concrete had been placed, indicated that practically no visible leaks remained; a few temperature hair cracks showed, which were attributed to the uneven thickness of the lining due to uneven outbreak. A two-bag grouter was used on this work.

Lining tunnel

The concrete plant for the lining consisted of a 1-yd. mixer and a concrete pumping machine, set up first at the control chamber and later at the outlet portal as the work proceeded from the inlet toward the outlet. Concrete was pumped a maximum of 1,000 ft. and averaged 25 cu.yd. placed per hour, with a maximum of 34 cu.yd. From the mixer, placed on the side hill at the outlet portal, three 1-ton trucks fitted with elevated hoppers, hauled the mixed concrete to the pump when the latter was set up inside the tunnel; its final set-up was directly below the mixer. The forms consisted of steel ribs with wood lagging. The invert was first placed to mid-height of the tunnel, and then it was placed at the arch.

FIG. 5—THE MUCKER was an old steam shovel operated with air; the boom was sawed off to a 6-ft. length.

Concrete for the side walls and floor of the outlet spillway was placed in part directly from the trucks and in part by pump. Forms on the slopes were supported by steel cantilevers projecting over the finished slabs, in which anchors had been cast for the purpose. The thickness of the slabs is 18-in. average and 12-in. minimum. The pool for the dissipation of energy at the outlet is 111 ft. long and 25 ft. wide on the bottom, with 1-on-1 side slopes.

Aggregate was gravel obtained a mile downstream from a river-bank pit, where a screening plant having a capacity of 500 yd. per 24 hours was set up. Practically the whole of the bank run could be used, making three grades: sand below $\frac{1}{4}$ in., $\frac{1}{4}$ to $\frac{3}{4}$ in. and $\frac{3}{4}$ to 2 in.

A subcontractor on the job, who first served the diversion-tunnel contractor and later the canal contractors, built up stockpiles from which he delivered aggregate to all of the jobs. It is from this same area that it is expected the sand, gravel and clay fill in the dam will be taken.

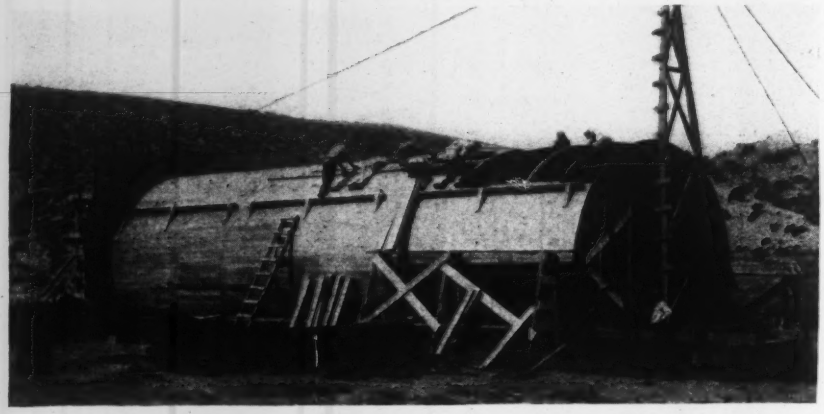


FIG. 6—FORMS FOR TUNNEL LINING were steel ribs with wood lagging.

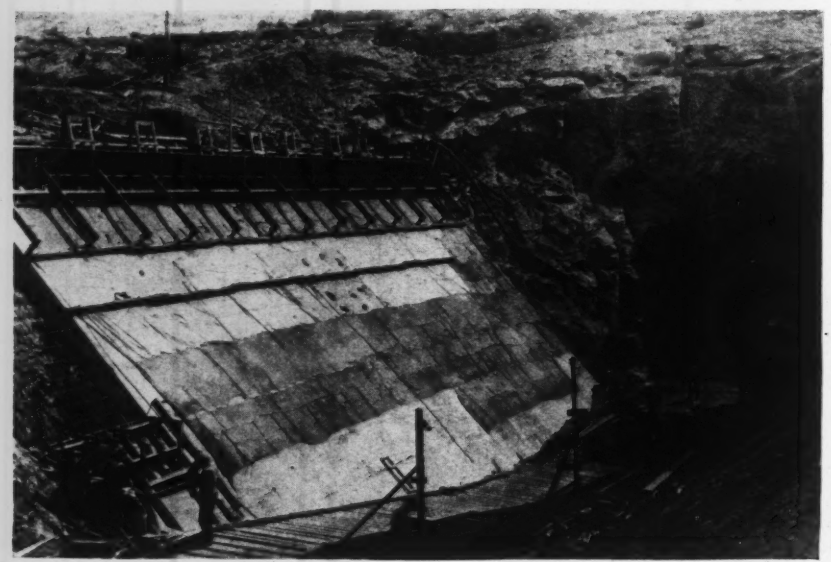


FIG. 7—FORMS FOR THE CHANNEL LINING were supported by cantilevers held by anchors set in the finished slab.

Direction of work

The diversion-tunnel contractor was the Lawlor-Woodward Construction Co., who sublet the tunnel excavation to Crook & Henno and the stripping, screening and stockpiling of the concrete aggregate to the Mountain States Co.

The work started Nov. 1, 1933, and was completed on Oct. 12, 1934. All work on the diversion tunnel was done under PWA regulations. Labor was at first brought in from Casper by a bus operated by the contractor, making four trips per day, for which a charge of 50c. per round trip was made. Later the contractor erected bunkhouses and operated a commissary, so that half the men stayed on the job. Board and a bunk were furnished at $1.20 per day to the men.

The maximum number of men used was 275, and the average over the eleven months of operation was 200 men. A safety record was made as no one was seriously injured on the job, though there were two fatalities and several accidents to workmen on the highway running between Casper and Alcova.

The Casper-Alcova project is being carried out under the direction of the U. S. Reclamation Bureau, for which H. W. Bashore is construction engineer in charge and I. J. Matthews office engineer.

The headquarters are in Casper. H. E. Robinson is resident engineer on the job.

Beach-Protection Work on California Coast Roads

Groins and seawalls of various types used extensively — Concrete has lasted well — Seawall at Ventura made of steel sheetpiling with timber top

GROINS ARE EFFECTIVE in forming and retaining sandy beaches. The sand on this 3,000-ft. stretch of beach is ascribed almost entirely to the groins shown.

SINCE construction of a highway along the California shore from Oregon to Mexico was made an objective of the California state highway commission some years ago, it has become necessary to protect the toe of fill slopes close to the surf on many miles of new highway construction along this route. Also, it has become desirable to construct works that would build up and retain sandy beaches, which are in great demand, as the highway makes new shoreline accessible. The coast route between Santa Monica and Oxnard, whose construction was completed five or six years ago, gets a terrific pounding from waves beating against the toe of the steep fills. The placement of precast concrete cribs along the toe of these slopes, put in during the early stages of the work, was described in *ENR*, May 30, 1929, p. 872. Practically none of that early crib construction has been lost, and since then much additional work has been done. The new shore-protection work along this route includes various types of groins, revetment and seawalls, of which some of the more important are described in the following.

For 60 miles along the coast route north of Los Angeles the location skirts steep slopes most of the way. In this distance a total of 13,000 ft. of monolithic concrete seawall has been in place for an average of five years, and of this total length only 250 ft. has been broken up by wave action. Even this small quantity is not a total loss because large broken fragments of the concrete remain and will aid in protecting the toewall for later monolithic construction.

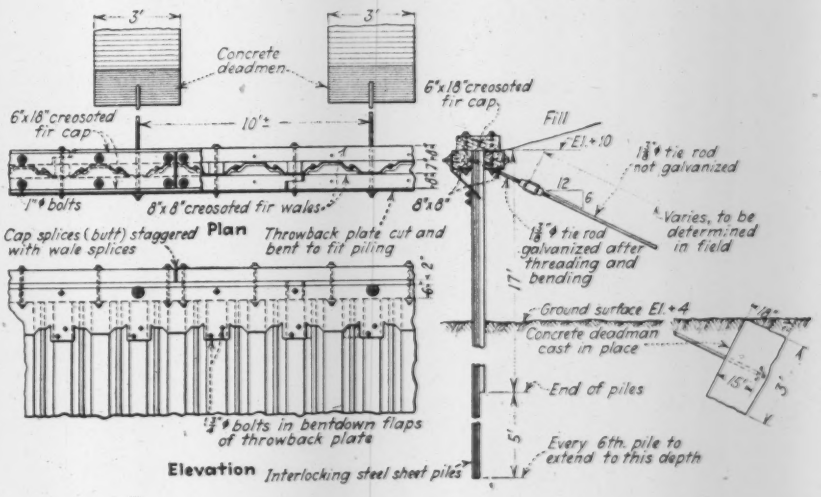
Along most of this 60-mile stretch the water close to shore is quite deep, which makes for extremely heavy wave action on the exposed promontories. In bad storms considerable quantities of water sweep across the pavement 35 ft. or more above high-tide level. The extreme tidal range is about 8 ft.

Three types of seawalls have been used extensively:

1. Along the steep rocky slopes that border deep water, monolithic concrete is poured in calm water at low tide using quick-setting cement, often with a small percentage of gypsum added. The walls are made 4 to 5 ft. thick and are topped off with a parapet overhanging the ocean face of the wall by about 18 in., to turn back waves. For the most part these seawalls constitute the toe and anchorage for rockfills made by dumping spoil over the edge of the highway grade. A few such walls have incorporated within their lower portions the old precast concrete cribs mentioned in the foregoing. In some of the more exposed locations, however, tiers of the original precast concrete cribs remain intact after six years of service and are functioning now as effectively as when built.

2. The second type of seawall is a steel and creosoted timber structure used along beach areas where the outer edge of the roadway needs some protection but where wave action is not frequent or severe enough to require the heavy concrete wall. The most extensive example of this is a 3,000-ft. length of protective construction along the highway just north of Ventura. Here the sheetpiling used is $\frac{3}{8}$ in. thick, weighs 36 lb. per ft., and the lengths required range up to about 22 ft. A $\frac{3}{4}$-in. steel-plate throwback, formed to fit the top of the piles as shown in the accompanying sketch, is used to make a smooth joint between the steel piling and the cap of creosoted timber. The cap usually consists of three pieces of creosoted timber of the sizes shown in the sketch, fastened firmly to the top of the piles by bolts. The hardware is galvanized; the sheetpiling is painted with hot grade E asphalt to a depth of 1 ft. below ground surface. It is to be noted that this type of construction entails a risk of fire as a result of beach parties building

DETAILS OF CONSTRUCTION of the low-cost seawall north of Ventura.



STEEL AND TIMBER SEAWALL along the highway north of Ventura. Details are shown in the drawing on the preceding page.

camp fires against the shelter provided by the seawall. This construction can be put in for about $17 or $18 per lin.ft. as compared to $75 to $100 per foot for a concrete seawall in sandy locations where a temporary bulkhead first has to be constructed on the ocean side and where excavation to solid foundation is required. Thus, the steel sheetpiling provides an effective form of protection for less than one-quarter the cost of the average concrete seawall.

3. A third form of seawall of still lower cost is provided by excavating a trench, usually 4 to 6 ft. deep and of roughly square cross-section, into which granite rock fragments are dumped. The rock sizes range up to 4 tons, with a specification requirement that not more than 75 per cent shall be less than 3 tons, not more than 50 per cent less than 2 tons, and not more than 15 per cent less than ½ ton. The trench is to provide an anchorage by getting the base of the fill down well below the existing beach ground level. The rock wall ordinarily is carried up to a height of 8 or 10 ft. above the ground level. Where the material can be dumped directly from trucks, the cost of this granite seawall, figuring a haul from the quarry not to exceed 5 miles, is roughly estimated at $1.65 to $1.75 per ton. However, in the case of the work north of Ventura, the riprap was hauled 100 miles by rail, then transferred to trucks by a clamshell and hauled 1 to 3 miles farther. The bid price on this work was $2.50 per ton.

Groins hold and build beaches

Excellent success has attended the use of groins put in along sandy beaches at right angles to the shoreline, to prevent erosion and to catch and accumulate sand deposits. Most of these groins consist of ⅝-in. steel sheetpiling 12 ft. long at the inshore end and 18 ft. long at the outer end, some 200 ft. from shore where the usual water depth is 10 to 12 ft. These groins are capped with 6x12-in. creosoted fir timber caps bolted to 10-in., 30-lb. channel wales, which, in turn, are bolted to the piles.

On one stretch of about 3,000 ft. of shoreline five groins of the type just described were put in at 600-ft. intervals for a total cost of about $25,000. This work resulted in building up the excellent beach shown in the accompanying picture, along a stretch where there was practically no sand beach before the groins were put in.

Concrete groins

In some locations similar groins made of concrete have been used and have been highly successful. However, concrete groins are regarded as practical only where road crews under expert direction are able to work economically at intermittent periods during calms, at extremely low tide, and as often during the night as in the daytime. These requirements are imposed because work can be carried on only for short periods at a time, and these periods vary daily with the tide; also work may become altogether impracticable for considerable periods because of bad weather. Even where the requirements of this rather unusual form of construction can be met, the concrete groins built by hand methods in sandy beaches have inadequate foundations and their length of life is problematical because of the danger of their being undermined and broken by wave action. It is significant, however, that none of these concrete groins have thus far suffered any undermining, and it may be that their beach-building effect on the littoral drift to the south, which is characteristic of the entire California shoreline, may afford some protection from this danger.

Work along the coast route mentioned in the foregoing is under the direction of S. V. Cortelyou, division engineer, California state highway commission.

Kansas Reduces Taxes to Landowners Who Build Reservoirs

KANSAS LANDOWNERS are permitted a reduction in the assessed valuation of their property for storage reservoirs built on dry water courses with catchment areas that do not exceed ten sections (6,400 acres). The reduction in valuation is based on the unit of $40 per acre-foot of storage capacity provided. This provision in the Kansas water-storage law was placed on the statute books in 1933 and was of material assistance in last summer's drought emergency in inducing owners of land to cooperate with the Kansas Emergency Relief Committee in the building of small dams. These structures are being built by relief labor and persons on the homestead-rehabilitation rolls. Further, community storage reservoirs are being constructed, with the relief agency providing some of the equipment and materials required.

John G. Stutz, director of the relief committee, believes that these numerous small reservoirs and ponds scattered over the state will assist materially in water conservation. Even seepage from the reservoirs will provide replenishment of underground storage which will, in turn, be available for wells.

To entitle an owner to the tax reduction, the dam must be built in accordance with plans submitted to the state division of water resources, of which George S. Knapp is chief engineer. The entire construction program, from the making of initial surveys to the laying out of the structure and a final inspection by the state department, is supervised. If all the work is approved, the state engineer certifies to its completion and acceptance, and a notice is sent to the county commissioners who make the reduction in assessed valuation on the owner's property.

To aid in this type of construction work, Mr. Knapp's office has compiled a 20-page pamphlet of instructions, including drawings of a typical earth dam showing requirements to be met for spillway, crest width, freeboard slope protection and other dam elements.

Continued Public Works Favored by Reader Poll

Extension of government's emergency construction program for recovery advocated by 85 per cent of voters—Non-federal projects best, grade-crossings and highways in the lead—Force-account methods condemned by overwhelming majority

ENGINEERS and construction men strongly favor continuance of the government's emergency construction campaign. They hold that it is justified primarily as an agency of business recovery rather than for relief, according to a poll of its readers just concluded by *Engineering News-Record*.

Questions that bear on leading problems involved in the government's construction program were included in the poll. The results are regarded as significant, for they represent opinions of trained engineers and constructors, most of whom have been in close contact with the current public-works campaign and are qualified to speak from experience.

Principal conclusions

The principal conclusions of the vote are summarized as follows:

1. *For a Continued Recovery Campaign*—An 85 per cent vote was cast in favor of continuing the government's public-works construction. By a still larger vote (9:1) the belief was expressed that the campaign should be carried on for recovery rather than for relief.

2. *Best Fields of Work*—The largest volume of useful projects for quick construction is to be found in these fields, in order of preference: (a) non-federal public projects; (b) federal projects; (c) housing. The six types of project listed as best by the voters are: grade-crossings, road and street improvement, waterworks and sewerage, bridges, flood control and housing. Post offices and municipal buildings ran a poor last in the vote.

This result confirms the belief that the needed improvements of cities, counties and states offer the readiest and most widely distributed means of accomplishing quick mass re-employment through emergency construction. It indicates that the large number of PWA applications accumulated after exhaustion of the $3,700,000,000 fund should be used for early beginning on any new program that Congress may authorize.

The poll also brought out the opinion that last year's PWA campaign has not exhausted the list of desirable and eligible local improvement projects. This agrees with the fact well known to public service engineers and officials that few, if any, communities are adequately developed in their service facilities. Additional applications may therefore be expected if it is known that the PWA is prepared to receive and consider them. It should be said that the question through which this result was brought out made no reference to financing, and the vote, therefore, gives no opinion on the ability or willingness of local communities to incur further obligations.

Requirements of success

3. *Decentralized Engineering and Construction Control*—For speed combined with soundness a large part of the administration of the program should be decentralized, the voters hold. A 3:1 vote favored decentralized control of engineering, inspection and disbursement. On the other hand, opinion was almost evenly balanced between centralized and decentralized control authorization and bond contract approval.

4. *Prevailing Wages or Zone Rates*—Wages should be governed by local prevailing rates instead of PWA zone rates or a countrywide fixed minimum (vote 2:1).

On the question of whether existing PWA rates are properly adjusted, or are too low or too high, an interesting division of opinion was recorded with regard to unskilled and skilled labor, respectively. In both cases the vote was decisively against increasing the PWA scale. For unskilled labor a slight majority favored maintaining rather than lowering the rates. For skilled labor the prevailing opinion (5:4) was that the PWA rates should be lowered.

5. *Hiring from Relief Lists*—Relief lists should not be used in the recruiting of skilled labor (vote 4:1). On the question of hiring unskilled labor through relief agencies the vote was approximately even.

Day-labor work opposed

6. *Force-Account Work* — Force-account work should be prohibited in carrying out a recovery program of public-works construction, or in any event should be restricted (vote 9:1 for prohibiting or restricting). This vote means that in the judgment of engineers and constructors recovery construction should be done by competitive contract where possible.

7. *Working Conditions* — Where force-account work is carried on, it should be under the same wage, hour and purchase conditions as those enforced in contract work (vote 12:1). The vote expresses the conviction of men familiar with the construction industry that city officials and other governmental authorities taking part in the emergency program should be required to observe the same maximum-hour and minimum-wage requirements, whether PWA or code, as for work let under contract, and that their purchasing should be governed by the regular practices of fair competition, without the permissive reduction under code prices that has been current for some months past.

Additional comments

Numerous statements amplified the opinions expressed in the poll. They represent thorough and constructive thinking. Pertinent excerpts from these statements are given in the following.

The public-works plan

From the numerous comments on the effect of public-works construction as a recovery measure, and its relation to relief activities, the following views are cited:

——"The PWA program may not be the best possible, but it is now in operation, and its weaknesses and difficulties are known and can be corrected. The installation of any new program would probably involve another year of delay. The financing of all private projects should be done by the banks, all of which are now subject to considerable federal supervision. Public non-federal projects are preferred, as they require the least degree or percentage of removal of the working man from his home and family in order to get to his work."

——"Non-federal PWA jobs have been productive of more good than any other measure to relieve the prevailing situation, as they are widely scattered, almost invariably cover much-needed projects, are economically and efficiently designed, supervised and constructed, and return the largest good in both structures built and relief accomplished."

——"The respective fields of activity of FERA and PWA should be strictly defined and separated. The major projects in which materials are a substantial factor should not be undertaken through FERA. The financial and legal departments of PWA should be liberalized and their work speeded up."

——"A properly planned and executed public-works program by the federal government is an urgent necessity. The success that such a program attains will, I think, be measured by the care with which it is planned and the freedom from red tape and political influence with which it is executed."

——"We have been making mistakes all along. Relief and recovery through construction are two separate, distinct problems and must be dealt with separately and differently, and not confused. Each must be administered and executed separately by experienced, trained and properly equipped organizations or agencies that know the local conditions and know the jobs they

are undertaking — not by political appointees, inexperienced, inefficient and disinterested."

——"The rule should be enforced that would classify work that could be performed as relief projects. Many municipalities at the present time are performing work as relief projects that should be listed as PWA work."

Criticisms of the plan

Some of the comments were strong in objections to a continuation of public works; others offered criticisms of present features of the PWA plan. Several of each of these classes follow:

——"Public works should be discontinued because they are being used without judgment and for the purpose of buying votes—witness Grand Coulee and Fort Peck. They will be continued because they do buy votes and will continue to do so until we begin to pay the bill in earnest. We have not yet begun to pay. The federal housing act is a constructive measure. Private lending agencies should have inaugurated some similar scheme many years ago. They preferred to gouge the public. Much as I deplore government in business, I do not know of anything else which promises improvement in this field."

——"The English dole should be substituted for public works. Let us be taxed for a straight dole so that private capital can gradually absorb unemployment. This extravagant federal program is producing artificial recovery which will end in disaster."

——"The PWA campaign should be modified to cut red tape and to eliminate official incompetency. Combine CWA speed with PWA soundness."

——"Certain communities have benefited by relief projects rather than PWA work. Construction undertaken with TERA labor employed more of the unemployed than contract work possibly could. However, the work is just what the supervision makes it, and the success of the whole plan hinges on that one fact. I am not in favor of the present TERA set-up with its top-heavy office forces, estimators, inspectors and the like. This overhead should be cut and the administration as a whole placed in the hands of a few seasoned, hard-working, honest and sincere men in each locality with political influence prohibited by law."

——"We would all be better off if the PWA program were entirely discontinued and common sense used in its place. I recommend that the government lay off all artificial programs and proceed to push all proper developments which will not interfere with private business and which are a problem that the government should take care of. These should be handled without consideration of any codes or such illegal devices."

——"Take the PWA out of politics. Put it under a board of one engineer, one contractor and one architect."

——"Place the disbursement of funds, engineering control and inspection under the direction of the U. S. Engineer Department."

——"The present federal public-works program has failed to produce the desirable effects on business which might have been realized by a different procedure, this being due to a variety of causes, including the following: the halting manner in which the program was put under way, the diversion of a substantial part of the preparation to purposes having little or no relation to public works and the indisposition or inability of the authorities to eradicate the relief idea from the public-works program and put the latter on a sound basis. The PWA is now a going organization and ought to be able to function more rapidly and avoid some of the past mistakes."

——"The trouble now is too much authority centered in Washington, with too many unworkable features and conflicting departmental provisions."

——"The PWA campaign should not be continued, and re-employment and business stabilization should be left to natural recovery."

——"The PWA administration is a failure. Too much undivided responsibility. Procedure is too slow and organization is inefficient."

——"With the exception of road work done under the direction of the Bureau of Public Roads, it is our observation that the whole purpose of PWA has been impeded through the supercritical compliance requirements that have governed the grants and the consequent delay in getting work under way. While in this state (Texas) many millions of dollars have been tentatively allotted, practically no PWA work has yet been done, and the purchase of involved 'capital goods' has not yet been consummated."

Labor and wage rates

Much criticism was directed against the wage and labor provisions of the current PWA campaign. Employment from relief lists was widely criticized. Failure to make adequate provision for professional workers brought out numerous expressions demanding change of procedure. Following are several suggestions and comments as to corrections to be considered in any future plan.

——"No public-works campaign or any other recovery measure can succeed until the fundamental matter of wages and hours is brought down to a basis of plain common sense."

——"Labor-saving devices should be prohibited and men put in their place."

——"Omit all hand and team labor jobs and omit requirements of where and whom to hire. Use machinery to the fullest extent possible."

——"All unemployed should have equal consideration for employment, and a man should not be penalized because he is unemployed but not on relief."

——"The regulation which requires a contractor to secure his workmen through a local federal employment bureau has been the biggest curse that construction workmen and contractors have ever had put upon them."

——"There is still an urgent need for the relief of unemployed among professional men, skilled laborers and common laborers. It is also essential that construction equipment be again placed to work and that recovery of normal business be aided through government financing under some plan similar to PWA. With a state PWA organization competent to pass on engineering plans, financing and authorized loans, the present long periods of preliminary negotiations could readily be reduced to less than half."

——"Any continuation of the public-works program must include some provision to protect the standing and pay of professional men who conceive, plan and direct the work. Precedents set by PWA, CWA and codes, establishing wages for engineers below that of mechanics, have made it difficult for engineers to get fair recognition of their worth."

——"If a project is approved, have a competent engineer draw plans and specifications, advertise it and let it to the lowest and best bidder that qualifies. Let him hire and fire his own labor, and pay the prevailing rate of wages that is being paid in that territory and have the work under strict supervision of a competent engineer. If we do that, we will get more for our public money, and I think that more men who will work will get work."

—"Place the PWA wage scales under code or zone wages so that work on PWA projects will be the second choice of workmen and not a 'gravy train' that anyone can ride."

——"All skilled and semi-skilled workers should be allowed to remain with the contractor without permission from the employment bureau. The method of requiring new men to be used on expensive equipment while experienced operators walk the streets is tremendously costly to the contractor."

Other types of projects

Some of the voters suggested types of projects other than the twelve listed for consideration in a new plan. Reclamation, research, erosion control, reforestation, surveying and mapping were some of the types suggested. Following are a few comments on types of work suited to public works.

——"The types of project involving erosion control, marginal land reclamation, flood control, sewage disposal and water-supply development, which are of value not alone to those residents in the immediate area but to a much larger population in the economic tributary area, should be given rational consideration of the over-all value of such sites. Future PWA activity should stress this type of broad development rather than many of the isolated and individual projects associated with the current PWA campaign."

——"Grade-crossing elimination with work under the management of the railroads, with funds supplied by the government and state, is one of the most fruitful fields."

——"Grade-crossing elimination would put more money to useful purpose with greater speed and with wider distribution than any other type of project."

——"A great deal for relief would be found in flood-control projects confined to the minor tributaries of the flooding streams. Soil erosion, reforestation and drainage projects should be incorporated in flood-control projects."

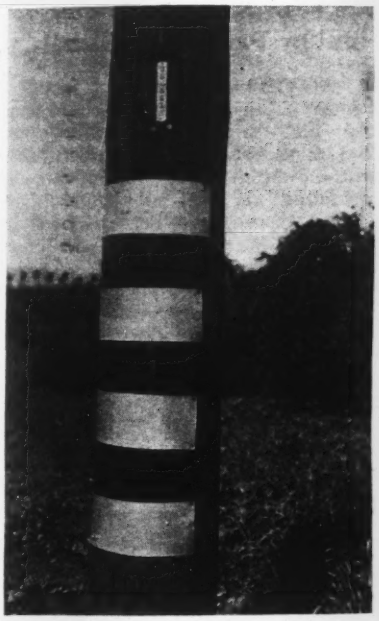
——"Suggestion for small towns: Arrangements should be made for labor on municipal projects by FERA and materials by PWA bonds."

From Job and Office

Safety Markers on Poles Indicate Road Margins

THE DEVELOPMENT of some form of marker that would make more conspicuous the telephone or other utility poles standing close to the shoulders of California highways has been a process of evolution extending over several years. The form of marker now coming into widespread use in that state is an effective and inexpensive scheme, a typical example of which is shown in the accompanying picture.

The function of the markers primarily



TYPICAL metal pole markers which make roadside hazards conspicuous for night drivers.

is to make the poles as conspicuous at night as is possible for a reasonable cost. Early methods were simply to paint the post white for the first 4 or 5 ft. above ground. This involved a considerable maintenance item because the paint had to be renewed at frequent intervals. When poles with creosoted bases came into extensive use, white paint was no longer effective over the creosote, so maintenance crews resorted to wood strips, usually lath, painted white and tacked on each pole on the side toward approaching traffic. Maintenance of the white strips proved even more costly than painting the entire pole bases had been.

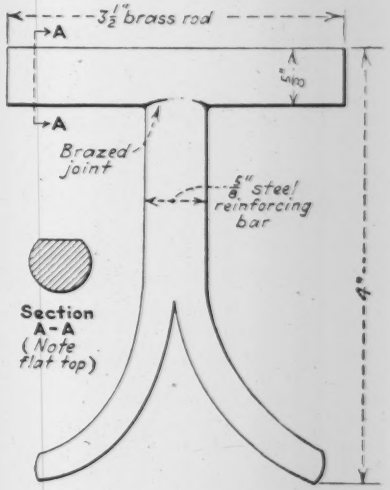
Then a change was made to thin metal plates about 5x12 in. in size, sprayed with aluminum paint and tacked to the poles in irregular position so as to give an outline as irregular as possible. These plates have been found very durable, relatively inexpensive, and they require less maintenance than any type of pole marker heretofore tried on the California highway system. A large number of the plates are laid out on the paint-shop floor, and all are sprayed at once with aluminum paint. Maintenance crews keep a supply of these plates on hand, to be put on as needed.

Spud for Use in Tunnel Marks Line and Grade

A MEANS of installing benchmarks in tunnels of the Los Angeles metropolitan water district aqueduct in such a way as to minimize risk of their being disturbed involves the placing of a brass spud in a small concrete pier set approximately in the center of the tunnel track. The piers are placed at 500-ft. intervals, and the station and elevation are stenciled on a board fastened to the lining timbers near by. As time permits, tunnel survey crews do this work in two separate operations; the first is to place the concrete pier between the rails of the track, and the second is to mark the exact line on a spud that was imbedded in the concrete for that purpose when the concrete was poured, and to determine its elevation accurately.

The concrete blocks are made about 10 in. square and deep enough to set firmly in the rock, so they are not likely to be moved by work on the track. The pier is put down low enough so that a 1-in. board on its top will be below the upper surface of the ballast. (The board has cleats on its under side to prevent splitting.) When the concrete is poured, a metal spud of the shape shown in the accompanying sketch is imbedded in the pier with its top slightly above the concrete surface.

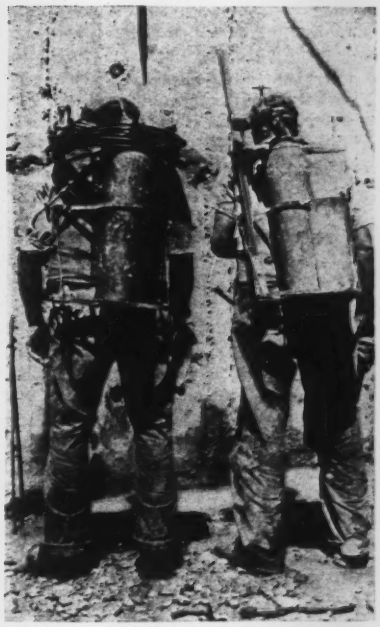
The brass rod constituting the top of the spud is set transverse to the center line of the tunnel, and its flattened upper surface is the benchmark on which the level reading is taken. When the spud



METAL SPUD to be placed in concrete pier in the center of the tunnel floor.

is lined in, the point on its flattened top exactly under the plumb bob tip is marked with a center punch.

PORTABLE WELDING OUTFITS



OXY-ACETYLENE welding has been an important aid in all stages of the Boulder Dam construction. These special carriers and cylinders of welding gases were used during the sealing of copper grout strips and in other locations inaccessible to ordinary welding equipment.

Sign Conventions for Bending Moments in Rigid Frames

By Robins Fleming

American Bridge Co., New York City

THE sign conventions used for bending moments in rigid frames are of many kinds. Professor Hickerson, of the University of North Carolina, in a recent monograph, "Structural Frameworks," 1934, uses the convention of rotation in the derivation of formulas or in the solution of problems dealing with continuous frames. End moments that tend to rotate the joint in a clockwise direction are *plus* and the reverse *minus*. In the formulas and coefficients given in the tables of this monograph bending moments are positive if they tend to sag the beam or cause compression in the top fibers; the same rule is used for moments in columns if the

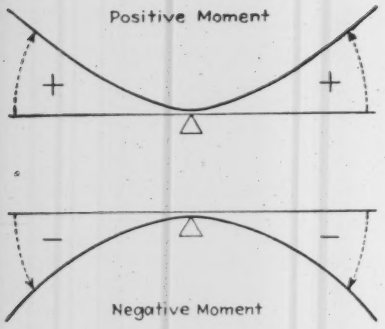


FIG. 1—SKETCHES showing sign convention involving sagging and humping of a beam.

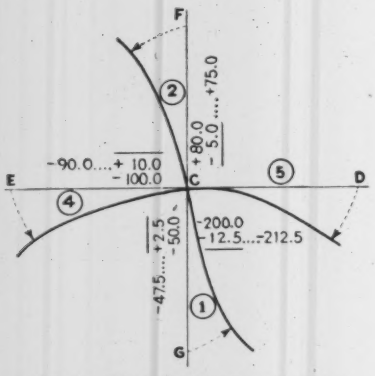


FIG. 2—DISTRIBUTING unbalanced moments of a joint.

column is looked at from the right-hand side of the sheet. Moments are minus if they tend to hump the beam.

Professor Brumfield, of Cooper Union, New York City, in an unpublished monograph, "The Solution of Statically Indeterminate Structures by Transmission Coefficients" introduces a convention of his own. Instead of the words *positive* and *negative*, to describe bending moments, he uses the terms *normal* and *reverse:*

"A beam is said to have normal bending moment at its end when its curvature there is the same as it would have if the member were flexed to resist a clockwise twist applied to the joint at that end by some external means such as a crank.

"A beam is said to have reverse bending moment at its end when its curvature there is the same as it would have if the member were flexed to resist a counter-clockwise twist applied to the joint at that end by some external means such as a crank."

The kind of bending moment is designated by an arrow. If the arrow points to the right, it means a normal bending moment; and if to the left, it means a reverse bending moment.

Notwithstanding the vigorous exceptions that have been taken, the writer has a preference for the convention used by Professor Cross in his outstanding paper, "Analysis of Continuous Frames by Distributing End Moments" (*Transactions*, Am.Soc.C.E., Vol. 96, 1932, pp. 1-156). Positive moment sags the beam, and negative moment humps the beam (see Fig. 1). That is, moments causing compression in the top flange are positive, and those causing tension are negative. The same convention is used for vertical members by rotating the sheet through 90 deg., so that the right-hand side becomes the bottom.

Fig. 2 illustrates the procedure of distributing unbalanced end moments. The moments at ends of members converging at joint *C* are those given in Fig. 1 of the Cross paper mentioned. The relative K (I/L) values of the members are shown in circles. By reference to the sketches of Fig. 1, the curves on Fig. 2 are drawn. The moments tending to rotate members counter-clockwise are 100(CE), 80(CF) and 50(CG), a total of 230. To these is opposed the moment of 200(CD), tending to rotation clockwise. This leaves an unbalanced moment of 30.0 which, distributed in proportion to the K values, assigns 10.0 to CE, 5.0 to CF, 2.5 to CG and 12.5 to CD. To have equilibrium, the moments on CE, CF and CG must be increased and on CD decreased. It is evident that the hump in the beam CE caused by the negative moment 100.0 can be lessened only by the hump in the beam taking some sag, or the tension in the top flange must take some compressive stress. Thus, the 10.0 distributed moment takes the plus sign. In the same way the 2.5 of CG takes the plus sign. The moment +80(CF) can be lessened only by the sag taking some hump, therefore the 5.0 takes the minus sign. In the beam CD the hump of the beam or the tensile stress in the top flange is increased by taking more tension. The 12.5 thus takes the minus sign. The final moments are now —90.0(CE), —47.5(CG), +75.0(CF) and —212.5(CD).

The numerical sum of the counter-clockwise moments 90.0, 47.5 and 75 is 212.5; equal to the clockwise moment with a numerical value of 212.5. We thus have equilibrium or $\Sigma M = 0$.

If curves were drawn in broken lines on Fig. 2 representing the final moments, the direction of rotation from the original lines would show at a glance the signs of the distributed moments. To decrease a moment, the distributed moment has the opposite sign of the original moment; to increase a moment, it must have the same sign.

It is to be observed that the *algebraic* sum of the several moments is not 0. (This is one of the objections raised against the Cross method by its opponents.) It is further seen that the sum of the moments to the left of the joint *C*, —90.0 and —47.5 = —137.5, is equal to and has the same sign as the sum of the moments —212.5 and +75.0 = —137.5 to the right of the joint.

This completes the first cycle of operations in balancing the moments. The next step is to carry over from each end of each member one-half the distributed moment, *reverse the sign*, write it at the other end of the member and proceed with another distribution.

In wind-stress analysis, where the value of the moment and not its sign is wanted, and in determining secondary, be found more convenient. (See Cross and Morgan text on concrete rigid frame.)

An article, "Sign Interpretation in Slope-Deflection Analysis," by Professor Lothers of Oklahoma Agricultural and Mechanical College (*ENR*, March 3, 1932, p. 231) has been helpful to the writer in determining the compressive and tensile sides of members.

Stone for Vertical Drains Held by Perforated Barrels

A NOVEL METHOD of installing vertical blind drains behind abutments and retaining walls was developed at Syracuse on the New York Central track-elevation project. In advance of backfilling, old steel oil barrels from which both ends have been removed are piled on end, one above the other, against the battered backwall. As each barrel is placed, it is filled with coarse gravel to form a permanent blind drain. The barrels are then perforated to admit water to the drain. The Walsh Construction Co., contractor on the project, originated the idea.

PERFORATED open-end steel barrels filled with gravel serve as vertical blind drains on Syracuse grade-elimination project.

Letters to the Editor

Supreme Court Building Contract

Sir—With reference to the editorial paragraph in your issue of Sept. 27, 1934, p. 410, entitled, "The Price of Fame," quoting Comptroller-General McCarl's ruling with reference to the contract between the federal government and the firm of Cass Gilbert, Inc., on the nearly completed United States Supreme Court Building in Washington:

The contract for architectural services on this structure was executed between the federal government and Cass Gilbert, Cass Gilbert, Jr., and John R. Rockart, individually and severally, and not between the government and Cass Gilbert, Inc. We make this correction as a matter of information.

Also your readers will be interested to know that the issue has been satisfactorily adjusted, and the associates, John R. Rockart and Cass Gilbert, Jr., will continue to act, as provided in the original contract, until the completion of the building.

We may add that since the death of Mr. Cass Gilbert, Cass Gilbert, Jr., and John R. Rockart have been commissioned, and contract has been executed between them and the federal government, to furnish the architectural services for the completion and furnishing of the building.

JOHN R. ROCKART.

New York, N. Y.,
Feb. 1, 1935.

Continuous Beams

Sir—Mr. Gedo's comments in the Jan. 3, 1935, issue, p. 21, on the solution of continuous beams by the method of direct distribution, as published in the Dec. 20, 1934, issue, p. 782, are interesting.

The criticism that the knowledge of the fixed points makes it unnecessary to compute the fixed-end moments is based on a faulty premise. These points are fixed for the abscissa relationship only, but the ordinate values, which would correspond with the conjugate points of the graphical analysis of Nishkian and Steinman, are functions of the fixed-end moments, or the moment diagram areas and the position of their centers of gravity. The writers gave careful consideration to each method and came to the conclusion that the determination of the fixed-end moments involves less computation. Professor Cross evidently came to the same conclusion. Distributing fixed-end moments directly and finally in one cycle of operations gives the designer an accurate visualization of the true physical action of the deflected structure which could never be obtained by the use of the moment areas.

Since the publication of the article the writers have received a large number of complimentary letters in which the concensus of opinion seems to be contrary to Mr. Gedo's first comment. Designers who have used both the Cross method and the method of direct distribution find that less time is required to compute the c, p, f and m coefficients and to distribute the moment completely in one operation than to make several successive approximate distributions of the fixed-end moments. The real economy of time, however, is effected by the use of the charts.

The writers firmly believe that a quick, accurate and flexible method of designing statically indeterminate structures is a more satisfactory tool in the hands of the experienced designer than a compilation of formulae or coefficients which are necessarily limited. The use of such tabulated data or involved special formulae tends toward obscurity and laxity in design. It is obvious that the coefficients used in the method of direct distribution are susceptible to tabulation, but the authors have purposely avoided such procedure for the reasons mentioned.

JOHN C. SCHULZE AND
WILLIAM A. ROSE.

New York, N. Y.,
Jan. 19, 1935.

Roadways at Tunnel Portals

Sir—In your issue of July 23, 1931, p. 147, there is published "A Proposal to Relieve Congestion in Vehicle Tunnels" by Lochiel M. King. I think it of interest to state that the suggested solution, the case of a two-lane tunnel with widened inclines, has been applied to one of the most recent European tunnels, namely, the vehicle tunnel under the River Schelde at Antwerp, Belgium. Work began in April, 1931, and the tunnel was opened to traffic on Sept. 10, 1933.

The width of the roadway throughout the tunnel is 22 ft. 6 in. From the portal to the street grade the roadway width is increased to 29 ft. 6 in. The two upgrade and the one downgrade lanes are separated by a white painted stripe with rubber blocks.

The accompanying photo, taken at the portal, shows the widening of the roadway, the painted stripes, the rubber blocks and the upgrade traffic arrows.

LUCIEN F. GOEMANS.

Louvain, Belgium,
Dec. 6, 1934.

Wind Suction on Building Roofs

Sir—I have read with great interest the articles on aerodynamics by W. W. Pagon, particularly the one appearing in the Dec. 27 issue, p. 814. I note especially the experience with regard to the Ribe Cathedral in Denmark. We had a similar experience at the University of Chicago, when in the summer of 1929 the chapel, which had been roofed the year before, required repairs, due to the vacuum created by the wind on the lee side of the sloping roof, immediately south of the great tower. In an area about 30x40 ft., where the copper roof was wired down to the precast concrete roof slabs, the copper sheeting raised up as high as 18 in. in the center, due entirely, I am sure, to the vacuum effect. Inside, the chapel has a Gustavino tile-arch ceiling protected overhead by the precast concrete roof on steel trusses, so that wind pressure cannot accumulate under the roof between the tile ceiling and the precast slabs.

LYMAN R. FLOOK,
Superintendent Buildings and Grounds,
University of Chicago.

Chicago, Ill.
Jan 16, 1935.

PORTAL of the Schelde River Tunnel, Antwerp.

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Editorial and Publishing Offices at 330 West 42d Street, New York

February 14, 1935

Electrification Enters a New Stage

INAUGURATION of electrified railway passenger service between New York and Washington, a distance of 226 miles, would be a notable event at any time; it is especially notable in these depression days. The Pennsylvania Railroad is to be congratulated for its enterprise in carrying the project through, and the PWA rightly takes pride in completion of the project as the largest private enterprise financed with its funds. Electrification of the passenger service is to be completed within a month, and freight service will follow soon thereafter. Then for the first time in railroad history in this country the principal lines of one railroad in a region of dense traffic will be operated by electricity, 1,974 track miles in all, and it will be possible to determine the full benefit to be obtained from railway electrification. Heretofore electrified operation in regions of dense traffic has been superimposed on a steam-operated system to meet some special condition, with the result that the expensive adjuncts of a steam system have had to be maintained. Savings effected through their elimination now can be added to the direct savings anticipated from electrified operation.

An Accusing Figure

NO ITEM in the list of emergency highway expenditures printed on another page is quite as important as the figure for immediate reconstruction of weak and narrow bridges. It tells a moving story of rapidly advancing road-traffic demand, and at the same time it is an accusation of oversight or neglect on the part of road builders. Its true significance is better appreciated when it is noted that it represents only the work that can be started within three months; the actual need for replacing old bridges is represented by a figure vastly larger. Bridges, the key points of any road system, are key points also in safety of travel, for, while a road can carry any vehicle without undue risk, bridges have definite limits of capacity. Here, then, the road builder must begin his work of road improvement; and while in most cases he shapes his program accordingly, yet traffic requirements have grown so rapidly that the capacity and strength of bridges is constantly under challenge. Structures that seemed adequate only a few years ago, especially those on secondary roads, are now overtaxed by bus and truck loads. Bridges therefore, have a continuing claim to first attention. Zeal for extension of road surfacing, however, often causes this claim to be overlooked, as is well known to everyone who has occasion to travel by road, for he finds many stretches of modern paved highway joined by hazardous crossings on old, light and often unmistakably decrepit bridges. Delay in property acquisition and similar complications account for some instances of deferred bridge improvement, but making due allowance for such unavoidable delays, the fact remains that the number of weak and narrow bridges is startlingly large. It lays a charge of neglect against roadbuilders of which they should clear themselves promptly—by giving bridges a place of priority in the highway improvement program.

Non-Technical Activities

THE NON-TECHNICAL ACTIVITIES of the American Society of Civil Engineers over the past decade are summarized in a report of the society' committee on aims and activities published in *Civil Engineering* for February. The report should serve to refute the frequent statements that the society has gone serenely along through the depression devoting itself to learned discussions of stresses and strains but giving little or no thought to the business or professional problems of its members. Since the society began its unemployment relief work in 1931, more and more of the time of its officers and a larger and larger part of its funds have gone into the non-technical problems of its members. The decision of its executive committee to go into the public works movement in 1932 probably will stand as one of the most significant decisions in the society's history. By that action, the society, for the first time, threw its weight behind a national movement having no direct relation to engineering. Activities of other kinds, insufficiently emphasized in the report, include the work done in obtaining better pay for engineers on relief work, in objecting to violations of civil service requirements and in developing opportunities for engineers in government operations. Much of this has been missionary work, necessarily of a personal nature; but that it has been effective in a great many instances might be attested by a host of men who have benefited—both inside and outside the society.

Paving Brick Progress

AN AUTHORITY on ceramics recently stated that no clay product has advanced so much in quality and production technique during the past few years as has paving brick. Just as truly, few paving materials have shown greater improvement in methods of application. The significant fact is that this accomplishment had its origin in research, and that its present impetus is to be credited to scientific experimentation. The de-aired brick now being produced in a dozen factories and laid in scores of pavements was begotten in the laboratory of the curiosity of a "theoretical" worker. So also we find, as will be reported at length in an early issue, that laboratory research is advancing the designer of brick pavements well on toward the goal of being able to specify joint filler and cushion-coarse materials upon which he can depend to produce the results he requires. Thus, within months rather than years, experimentation has improved the quality of brick paving materials and their effective application. The broad field of mechanizing the process of pavement construction now challenges the ingenuity of the equipment engineer. At the moment, the materials and their production lead by a large margin.

Adding to the Record

BEYOND QUESTION the most valuable byproduct of engineering construction is the record of what was learned in overcoming its difficulties. Such a record is rarely contained in the description of the achievement itself. In the case of the notable foundations of the Bay Bridge, only the story of difficulties and experiences can make

known to the profession what was learned in carrying out the remarkable undertaking. In setting down this story, as published in the present issue, the engineers have made an important contribution to the literature of engineering. The history of how the huge caissons were manipulated as they went down in their mud submergence adds a new chapter to the history of caisson work and prepares the way for carrying out even more difficult undertakings. The final achievement of preparing a foundation bed at depths as great as 240 ft. below water surface and constructing competent footings at these depths is no less noteworthy. The excellence of the result, verified by divers who inspected the prepared footing bed, establishes that similar methods can be relied on at still greater depths, where inspection by even the most venturesome diver would be impossible. The scope and sureness of difficult subaqueous foundation construction thus is definitely enlarged by the record now presented.

Water Rights Confusion

IT IS IN KEEPING with the sensational history of the Casper-Alcova project that the surprising decision has been reached to reduce the acreage of irrigation development for lack of sufficient water, but nevertheless to go ahead with the project in spite of doubled unit cost. The important present feature of the decision is not its involved economic status, however, but the fact that it resulted from the same confusion over water rights that afflicts the entire western half of the United States.

The project change is due to the fact that the state authorities limited the federal water application, entered 30 years ago, in order to recognize claims of later upstream appropriations. This action—whose legal status remains problematical—disperses the use of the stream water without regard to the requirements of most efficient development of the North Platte basin as a whole. Similar conflicts of haphazard claims to the essential public resource of water, and similar dispersion of water use, mark the whole history of irrigation development.

Under the conditions of the past, when ample floodwaters usually remained, it was possible to correct the resulting harm by building reservoirs to save the floodwaters. Present-day conditions do not permit of such correction, as there are only small residues of available water. For this reason it is urgently desirable that water administration be modernized to assure the use of water in the best interests of the whole tributary area.

The principle that the broad public interest of the region should be considered before any appropriation rights to water are granted or any water use development is undertaken was strongly affirmed within recent months both by the National Resources Board and by the reclamation committee that reported on a survey of reclamation project conditions. All the evidence contained in present-day water problems in the West speaks for putting this principle into effect as quickly as may be possible. It is a vital factor in salvaging what remains of the water resources of the arid region.

That modernization of antiquated water law can make some progress is revealed by the recent California court decision which gives practical effect to the constitutional amendment adopted some years ago to permit of putting water resources "to beneficial use to the fullest extent to which they are capable." California waters since early days had been governed by a mixture of riparian and appropriation doctrine, and a riparian owner could require that streamflow "undiminished in quantity" be maintained through and over his land regardless of flood conditions or of whether he could make use of it. In consequence waters needed for storage to supply dry-season needs were often wasted to the sea in flood runoff. Much water-rights litigation of recent years, including the famous Herminghaus case, was decided on the older doctrine. In future such claims to flood rights will not be recognized.

Beyond the present limits of this decision lies the larger desideratum of assuring such utilization of water resources that they will benefit the whole region concerned—"to the fullest extent to which they are capable," in the words of the California law. In order that this purpose may be attained throughout the West, revision and modernization of haphazard water laws and practices is essential. The initiative in bringing about such modernization rests on the states themselves.

Making Construction Effective for Recovery

FOR MORE than a year the whole engineering and construction world has intently observed the recovery program of public-works construction. For the first time large-scale experience in mobilizing a great construction program for the welfare of the country as a whole was obtained. That experience should be of value in carrying out the new emergency program that is now before Congress for enactment.

To bring out the essential figures of this experience, *Engineering News-Record* some weeks ago called on its readers to contribute their views on the character and methods that must be embodied in such emergency construction. The results are now brought together in the summary appearing on page 255 of the present issue. They afford sound and logical conclusions on the scope, organization and conduct of recovery construction.

That an extension of public-works construction is in the national interest, and that it should be planned to serve recovery rather than relief purposes is recognized as clearly by engineers as by the citizenry at large. It is significant, however, that technical experience indicates the most fruitful field of construction to lie in the nonfederal projects, the needed improvements of states and cities, rather than in the huge federal ventures to which a large part of the recovery act fund was diverted. Grade-crossings and highways find recognition as affording large possibilities for quick employment. On the question of the methods of conducting the program, the result of the vote strongly confirms the views that have been repeatedly advanced in our columns. Wage and employment methods, well-known factors of trouble in the current program, demand reform.

Most important perhaps is the overwhelming condemnation of force-account construction that is found in the results. Here the experience of the construction field has been clear beyond question: the government's force-account operations have visibly produced unemployment and disintegration of established agencies—contracting architectural and engineering organizations—in a degree that caused the program as heretofore conducted to operate powerfully against continuing recovery. In these and related features the results of the poll point the way clearly toward the course of action in executing the new construction program.

CURRENT NEWS

Senate Committee Continues Hearing On Works Bill

(Washington Correspondence)

AN AMENDMENT to the $4,880,000,000 works bill was adopted on Monday by the Senate Appropriations Committee specifying that federal works on public roads, rivers and harbors, reclamation and public buildings, undertaken in the program, be handled under the regular, existing federal agencies, and that contracts performed be under the supervision of these agencies. Further, the committee voted to reconsider the McCarran amendment which provided for the paying of prevailing labor rates on works carried out under the funds. Proposals defining eligibility of unemployed persons and banning political patronage from appointments were defeated by the committee.

Corrington Gill, assistant FERA administrator, appeared before the committee Feb. 11 to present figures showing the increase in costs which would result from the prevailing-wage plan.

According to Treasury experts, this plan would raise the cost of the program to more than $6,000,000,000 and would defeat the purpose of making an incentive for relief workers to seek private employment. The prevailing-wage clause lost in the House by a scant margin and is heavily supported by labor spokesmen who fear that the proposed security wages, averaging $50 per month, will pull down private pay scales. A possible compromise is to specify short hours on the relief work which will mean low monthly earnings at regular hourly wages. Despite strong administration efforts to have the prevailing-wage clause stricken out, the outcome is far from certain.

The committee also voted that all possible use be made of the facilities of private enterprise and that jobs where 10 per cent or more of the employees are skilled labor be performed by contract awarded to the lowest bidder. The Philippine Islands were barred from receiving benefits of the fund. An amendment is being prepared to place appointees under Civil Service.

A proposal to cut in half the $4,000,000,000 lump sum and use the remaining $2,000,000,000 for direct relief lost by a tie vote. An amendment to finance the program by issuing greenbacks also was defeated.

Interests seeking to earmark highway funds in the bill have been waiting for the committee to report before taking action. Similarly action on the Cartwright bill in the House, proposing $400,000,000 for roads and $300,000,000 for grade crossing work, is being withheld.

Well-timed reports that relief funds were exhausted failed to move the Senate committee to hasty consideration of the bill. As expected, $50,000,000 was secured that, according to Administrator Harry Hopkins, will keep FERA going until Feb. 20, and there is more at the same source—the PWA.

New York Submits $1,000,000,000 Works Program to PWA

New York City plans to submit a $1,000,000,000 program of public works and improvements to the Publics Wor s Administration. The program was prepared under the direction of Mayor LaGuardia in response to the federal government inquiries which were addressed to cities for the purpose of securing a program of immediate works to be undertaken under the $4,000,000,000 work relief plan. The mayor announced that detailed plans and estimates were prepared for practically all of the projects listed and that work could be started almost immediately on the completion of satisfactory financial arrangements.

For financing, the projects were divided into those which would be carried in the city budget and those which would be separately financed both as to amortization and collateral, with the projects constituting the security for the loan.

The largest individual project on the list is the Delaware River water supply development totaling $272,000,000. Other large individual items include: 6th Ave. subway $57,639,000, 500 subway cars $19,000,000, municipal power plant $30,000,000, Ward's Island sewage works $45,245,000, criminal court building $18,500,000, East River elevated highway $18,000,000, and 142 elementary schools $82,240,000.

St. Louis Allotted $1,103,000 for Municipal Bridge Approaches

An allotment of $1,103,000 has been made as a loan and grant by the PWA to St. Louis for the completion of railroad approaches to the municipal bridge across the Mississippi River between St. Louis, Mo., and East St. Louis, Ill. About $1,400,000 which was advanced by the Terminal Railroad Association, already has been spent on the railroad approaches which will be completed with the PWA funds.

Professional Practice Course Announced at M. I. T.

A new graduate course in professional engineering practice has ben announced at the Massachusetts Institute of Technology under the direction of Prof. Charles M. Spofford of the civil engineering department. The work will cover ethical and professional codes of the engineer in relation to clients, contractors, fellow engineers and the public; a study of engineering costs and salaries, material specifications, and the preparation of contracts and technical reports. Other subject matter includes engineering office problems and methods, the preparation of construction estimates and project plans.

Iowa Engineers Debate Affiliating With National Professional Society

AFTER considerable discussion, at its Des Moines meeting Feb. 7 and 8, the Iowa Engineering Society has sent to letter ballot the question of affiliation with the National Society of Professional Engineers. An exhaustive presentation of the aims, the opportunities and the field of the N.S.P.E. was made by D. B. Steinman, its president, who is on a month's tour presenting proposals of affiliation to state societies. More than 200 were present at the meeting.

Prof. H. O. Croft, head of mechanical engineering, State University of Iowa, in a paper on "The Engineer and His Societies," agreed with Dr. Steinman in his diagnosis of the handicaps and difficulties surrounding the effectiveness of society effort looking toward recognition and improvement in the professional status of the individual engineer. He stated that he was decidedly opposed to "amputation" of the professional from the technical and believed in "activating and utilizing the organization we now have."

Discussion disclosed a marked division of opinion for and against utilizing the "weapon of attack" offered by Dr. Steinman. It was apparent that there were various reasons and even prejudices on both sides. Among these were misapprehensions and misunderstandings in regard to the purpose back of the new organization, opposition of the older organizations, what seems like an evident connection with the American Association of Engineers, which has identical aims and many accomplishments to its credit but in the minds of conservatives still has unionistic tendencies, dissatisfaction with the inactivity and accomplishments and presumed attitude of bourbonism of American Engineering Council (of which the Iowa Society has long been a member).

A motion to approve the plan temporarily, letting those who desired to do so to join the NSPE, and sending the proposal to letter ballot, was voted down almost unanimously, since it became evident that a split might develop should any gesture of approval be given. The letter ballot is to be accompanied by arguments for and against, giving time for thorough investigation and deliberation.

Sidelights on the "status" question were brought out by C. C. Coykendahl in a report of the public relations committee, in which he said that status is a question of relativity, not measured by prosperity. The engineer, he said, has shown leadership and has been given increased responsibilities in recovery and relief activities. The engineer, in his opinion, still takes too little pride in his professional attainments and contributes too grudgingly to his societies.

C. H. Currie, chairman of the legislative committee, explained the proposed changes

(Continued on p. 266)

IN WASHINGTON

By Paul Wooton

Washington Correspondent

The hat of George L. Berry, deputy administrator of NRA who has been handling construction codes, has been thrown into the ring as a candidate for administrator of the new work relief program. The suggestion is taken seriously, despite White House denials. Such an appointment would not be displeasing to the construction industry and would tend to offset other acts displeasing to organized labor.

Construction has a vital interest in the Administration's new banking bill. It provides a way for advances on mortgage paper by the Federal Reserve banks. Instead of the present arbitrary and restrictive limitations on collateral it is proposed to allow the banks, when desirable, to accept any good asset.

Hearings have begun before the flood control committee of the House of Representatives on legislation proposing to set up authorities in the basins of the Red, Arkansas, White, and Ouachita Rivers. Development of flood control, navigation, and power will be considered.

President Roosevelt's reference to "direct labor" in his work relief measure is being interpreted in certain government quarters as meaning hand labor. The attention of officials is being called to the fact that large use of hand labor would hinder rather than help recovery in the durable goods industries, which means large employment in the congested centers.

While Coordinator Eastman's report reconciles many divergent views of competing transportation interests, some see in it an adroit move toward government ownership. That and other features of the report are to be discussed at a conference of representative interested organizations to be held in Washington late this month. Among other things consideration will be given the establishment of a statutory advisory council of 27 members selected from the principal groups concerned.

Paving Brick Association Meet Emphasizes New Technical Data

Technical data on deaired brick, joint fillers and bedding material were presented at the annual meeting of the National Paving Brick Association in Indianapolis, Ind., on Feb. 6-8. The papers indicated that experiments were providing an approach to a positive definition of joint filler and bedding course compositions. Conclusions reached concerning deaired brick indicated that production technology and physical characteristics were not yet well enough determined to justify its recommendation as a standard product.

During the year the association undertook research work in a positive way through the establishment of a bureau at Ohio State College under the direction of W. C. Ruecket. The report of this bureau provided one of the important technical contributions to the meeting. A report covering the technical papers presented at the meeting will appear in next week's issue.

Highway Employment System Criticized by State Board

Contractors on NRA projects suffer by reason of inferior labor recruited from federal re-employment agencies, according to the Rhode Island state board of public roads in a report sent last week to the legislature. The board pointed out that bid prices on the emergency project contracts carried out last year under the federal highway building subsidy were often too low, considering the difficulties under which the contractors had to operate. "We are convinced by our own records," said the board, "that in some cases the cost of carrying out the contract was in excess of the money paid the contractor. Under the federal rules and regulations, the contractors were compelled to obtain all labor, including skilled, from the federal re-employment agencies, which seriously affected the efficiency of operation on the job. In many cases the labor was inferior to that which the contractor, if permitted, would have employed. Especially is this true in the case of skilled labor." The board strongly advocated permitting contractors to hire their own skilled labor within the state.

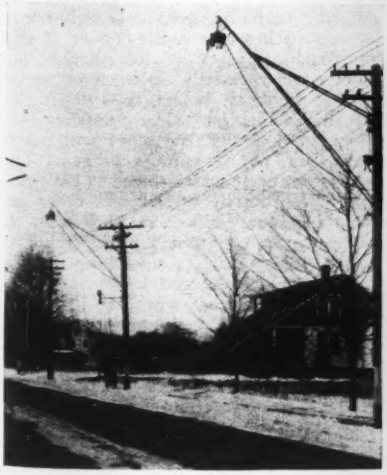
The report further declared that the failure of the legislature to appropriate the annual outlay for the fiscal year 1935 highway construction had seriously hampered its work. Only one state contract for road construction was awarded in the fall. Federal projects were shared from an unexpended balance in the general highway fund. Besides recommending considerable bridge reconstruction the board recommended grade crossing and highway improvements to improve traffic conditions.

ONE-MILE SECTION OF HIGHWAY LIGHTED BY SODIUM-VAPOR LAMPS OPENED IN NEW JERSEY

THE opening of a 1-mile section of highway lighting, illuminated by 30 sodium-vapor lamps in Pompton Lakes, N. J., was inaugurated last week with ceremonies including an inspection by highway and street officials. This test lighting section on a two-lane concrete highway was carefully designed to meet problems of night appearance, looks by day, position of light sources, and resulting illumination.

The lamps are mounted 30 ft. above ground, supported on poles spaced 115 ft. apart along one side of the highway. Arrangements have been made which permit the extinguishing of alternate lamps so that the illumination effect of varying the spacing may be observed. A special supporting truss of galvanized steel construction is provided on the poles to support, the lamps over the roadway. The fixtures are not set directly over the center line of the pavement but are offset several feet. The fixtures are constructed with six vanes of sheet aluminum arranged in an X-shape with two vanes forming a covering that affords protection against the weather. The two sides of the fixtures are set parallel to the sides of the roadway. The inside surfaces of the side and top vanes are highly polished to provide reflection and the bottom and two ends of the fixture are open for downward and longitudinal distribution of light. The side vane nearest the center of the roadway is angled slightly to provide an even distribution of illumination.

Westinghouse Electric & Mfg. Co. Photos



Code Authority Asks Employment Figures From Contractors

EMPLOYMENT and payroll statistics of the construction industry are to be sought from 150,000 registered employers by a questionnaire being sent out by the Construction Code Authority. The field of inquiry covers all construction work except that federally financed. Returns are to be compiled by the census bureau.

The questionnaire asks for the number of employees who have worked any part of a one-week period ending nearest to Jan. 15. The total amount of payroll and the total number of man hours are requested for the four-week period ending Jan. 26. These three items are to be given separately for journeymen and mechanics, helpers and apprentices, common labor, and office workers. In addition, the contractor is asked to give the dollar value of contracts received during the month of January, the dollar value of work performed during January with his own forces, and the dollar value of incompleted work as of Jan. 31. These figures are to be listed on the four major classifications: one and two family houses, other building, heavy construction, and highways.

In order to afford a comparison of employment and payrolls between 1935 and 1934, the contractor is asked to give for 1934 also the number of employees who worked any part of the week ending nearest to Jan. 15, 1934, and the total amount of payroll for the four-week period ending nearest to Jan. 27, 1934.

The report is to include new construction, re-modeling, repairs and maintenance. Federal government projects are not reported, nor are any projects financed by PWA or RFC funds.

The information is to be compiled by the Bureau of Census, and every precaution is to be taken to keep the reports of the individual contractors strictly confidential. Only compiled summaries for the entire industry will be published.

The 150,000 contractors to whom the questionnaire is being sent include 23,000 general contractors, 40,000 painters, 23,000 electrical contractors, 25,000 plumbers, 8,300 heating and piping contractors, 9,000 roofing and sheet metal contractors, 8,500 plasterers, and a smaller number of the other divisions.

Bids Received for Finishing Defaulted Buffalo Sewer Project

The city of Buffalo, N. Y., has received bids for the completion of the Fillmore-Lovejoy drain which was abandoned last October by the original contractor after completing nearly half of the work. About a year ago the original contract amounting to $964,000 was let to the Chippewa Plumbing Company of Buffalo, for the construction of the sewer under a PWA loan. Six bids received by Public Works Commissioner G. J. Summers for the remaining 52 per cent of the project range from $726,000 to $905,000, nearly the original contract price. The low bid was submitted by the Cornell Contracting Co., New York City. A statement concerning the default of the original contractor appeared in *ENR*, Oct. 25, 1934, p. 540.

Illinois Municipality Files Suit Under National Bankruptcy Act

The town of Gillespie, Ill., has filed a case in court under section 80 of the National Bankruptcy Act. The town seeks to cut in half, by agreement with its certificate holders, its principal indebtedness on a waterworks system built in 1922. The federal district court in Springfield has set Mar. 4 as the date for hearing of arguments in the case.

The plan provides for the waiving and cancellation of $100,000 interest on the $236,800 aggregate amount of principal, and a reduction of the principal by 50 per cent to $118,400. The interest rate would also be reduced from 6 to 4½ per cent. Most of the certificate holders, according to reports, are residents of the state of Iowa, with two individuals holding more than $100,000 of the total amount outstanding.

The town holds that the certificates are payable solely from the net earnings of the water supply system and that these earnings have been insufficient to meet obligations. The credit of the water system alone is involved in the bankruptcy proceedings.

Rio Grande Canalization Project To Be Studied with New Fund

Investigations to determine the feasibility of canalizing the Rio Grande River from the Caballo Reservoir site in New Mexico with the international diversion dam near El Paso, Texas, have been made possible by a Congressional resolution appropriating $50,000 for expenses of the American section of the International Boundary Commission. The investigation is being made to facilitate federal control of the river so that the United States can comply with its obligations to deliver to Mexico a total of 60,000 acre-ft. of water annually over a 7-months period.

Highway Commission Held Legal Entity; Can Be Sued

Holding that the Louisiana Highway Commission is a separate legal entity capable of suing and being sued, and is distinct from the state itself, the Fifth United States Circuit Court of Appeals has affirmed the decision of the lower federal court in the award of $12,950 to H. Pratt Fransworth, contractor, and $2,385 to the Jones & Laughlin Steel Corp. The plaintiffs had brought suit for damages arising from the cancellation of a contract for the construction of a bridge across the Vermilion River in Lafayette parish, by the Louisiana Highway Commission. In defending the suit the commission had contended that (1) it was the state of Louisiana and could not be sued and (2) that as the state of Louisiana it could not be subjected to the jurisdiction of the federal court. The decision of the higher court held (1) that the state act of 1921 which created the commission gave it legal entity to sue and to be sued and (2) that it was not the state and hence was subject to the court's jurisdiction. The finding of the higher federal court, according to reports, will be followed by the filing of several additional suits against the state highway commission.

New Highway Approach Route Surveyed for City of Montreal

Surveys have been completed and construction work may be started this spring for a new main highway approach route into the city of Montreal. The new location will use the old right-of-way of the Grand Trunk Railway, abandoned when the new Canadian National line was constructed. This new highway approach from the west would eliminate the present tortuous highway line. It would be constructed under the jurisdiction of the department of roads of the province of Quebec.

Postponement on Waterworks Project May Result in Loss of PWA Grant

SPRINGFIELD, ILL., has been warned by Administrator Ickes that it may lose its PWA grant of $415,000 unless it carries out the obligations of its contract and completes the construction of a waterworks improvement program which was financed by a PWA loan and grant of $1,385,000. A letter from the Administrator to the mayor of Springfield denied a request of the city council that it be permitted to obtain the PWA grant for already completed work without constructing the remaining and integral part of the water system, consisting of a filtration plant and clear well. The PWA has actually purchased bonds totaling $533,000 which are secured by revenues derived from the operation of the water system.

An investigation by PWA engineers, according to report, indicates that the failure to carry out the terms of the contract would not only result in partial abandonment of improvements already finished but would also, through impairing water revenues, threaten the value of the bonds now held by the PWA.

The commissioner of public property, Willis J. Spaulding, of Springfield, has countered the statement of the Administrator by declaring that the conclusion of Secretary Ickes is a result "either of misinformation or lack of information, and the city will certaintly insist on presenting its case in detail before the proper officials in Washington." Mr. Spaulding says, in explanation, that the plant will not be needed for ten or fifteen years. "This purification plant was included in the public works program by myself and other city officials in our enthusiasm to join in the public works program for the relief of unemployed by building something we were reasonably sure to need in the course of the next decade; but when we found that our projects were over-running our allotments by more than $100,000, we realized we were getting into deep water and it was time to call a halt. It was a mistake to include the purification plant in the first place, and there is certainly no justification in penalizing the city for attempting to correct its mistake."

Arizona Answers Federal Suit on Parker Dam Case

THE NAVIGABILITY of the Colorado River and the obstruction to be created by the Parker Dam are the main legal points raised by the State of Arizona in its answer to the Supreme Court of the United States on the suit filed by the federal government to secure an injunction against the state holding up construction operations on the project. At the present time work on this dam, which is being built by the Bureau of Reclamation through a contract with the Metropolitan Water District of Southern California, is being held up on the Arizona side of the river following the declaration of martial law at the site by the governor of Arizona.

Governor defends act

The brief presented by Arizona contained an extended statement by Governor B. B. Moeur which reviewed the case and outlined Arizona's position in its objection to the project being carried out in its present form. In addition to the question of navigability of the Colorado River, the governor referred to the recent contract which was drawn between the state and the Department of the Interior to provide 2,800,000 acre-ft. of storage for Arizona in the Boulder reservoir, which was not signed because of objections raised by other states in the basin. The governor stated, "I feel it is my duty as governor of Arizona to oppose and if possible prevent the proposed construction of the Parker Dam by and for the Metropolitan Water District of Southern California, unless and until its construction has been consented to by the state of Arizona."

Legal arguments

In the summary of the legal arguments presented by Attorney-General John L. Sullivan of Arizona are the following:

"(1) Arizona owns in its sovereign capacity the east half of the bed of the Colorado River, a navigable stream, where Parker Dam is proposed to be constructed, subject only to the paramount rights of the United States to maintain and improve navigation in interstate and foreign commerce.

"(2) The right of the United States to occupy and use the beds of navigable streams without the consent of the state having jurisdiction is found in the commerce clause of the Constitution and is restricted to activities undertaken by the government primarily with the intent to regulate interstate commerce and improve navigation. Neither Congress, the United States nor any of its executive officers can extend the authority of the national government under the commerce clause to reclaim public and Indian lands under the guise of improving navigation.

"(3) No dam or other structure which will obstruct navigation can be erected in any navigable waters of a state by any person without the state's consent, nor by the United States, except for the purpose and with the intent of regulating and improving navigation.

"(4) It appearing upon the face of the bill of complaint and the affidavits of Commissioner of Reclamation Mead and Secretary of the Interior Ickes in support of application for temporary restraining order that the Metropolitan Water District of Southern California is a real party in interest, the dam cannot be constructed without the concurrent consent of Congress and Arizona.

"(5) It appearing upon the face of the complaint that the construction of the dam is not positively related to the improvement of navigation, but, on the contrary, is an insuperable obstruction, not even the United States itself has authority to build it without the consent of Arizona.

"(6) The Secretary of the Interior has no power, constitutional or otherwise, to obligate the United States by contract with an individual or corporation with relation to the governmental functions of the United States or obliging it to act or not to act in its sovereign capacity.

"(7) The United States, in exercising its rights under the commerce clause to regulate and improve navigation, acts in its governmental and sovereign capacity.

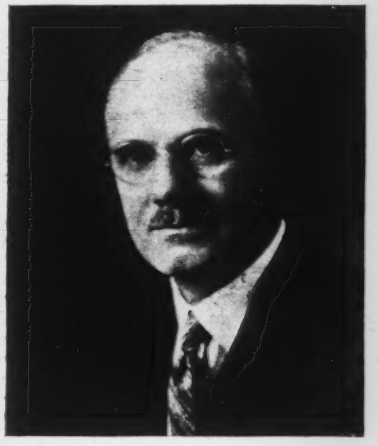
"Therefore, that portion of the contract between the United States, acting by and through the Secretary of the Interior, and the Metropolitan Water District of Southern California, by which it was sought to obligate the United States to improve the Parker Dam for the purpose of *'improving and regulating navigation'* (a governmental function) is void and imposes no obligation upon the United States.

"(8) As the United States acts in its proprietary capacity, as distinguished from its governmental, in the reclamation of arid lands, it cannot appropriate any property of the state of Arizona to such a use without the state's consent."

F. A. Gaby Elected President of Engineering Institute of Canada

Frederick A. Gaby, until recently chief engineer of the Hydro-Electric Power Commission of Ontario, was elected president of the Engineering Institute of Canada at its annual meeting held in Toronto Feb. 7-8. Mr. Gaby is assistant to the president, Canadian Pacific Ry., with headquarters at Montreal.

Mr. Gaby graduated from the School of Practical Science, Toronto University, in 1903, took postgraduate work for a year and then for three years was in electrical engineering work before going to the Ontario Hydro as assistant chief engineer. In 1912 he was made chief engineer and as



Frederick A. Gaby

such was in charge of the technical development of the Ontario Hydro-Electric Power Commission's system during the period of its greatest expansion. His connection with the commission was terminated early last year following an administrative change in the government of the province of Ontario.

A report of the annual meeting of the Engineering Institute of Canada will be published in next week's issue.

Permanent Planning Department Urged by New York Mayor

Speaking at a conference called by the Mayor's Committee on City Planning, last week, Mayor LaGuardia of New York urged the establishment of a city planning department as a permanent part of the city organization. The lack of any sort of a directed plan for the city of New York as a whole and the dismal failure of the present zoning law argue strongly in favor of such a move, in the opinion of the mayor. Also, so-called "flexible plan maps," which may easily be altered through political and other pressure, must be abandoned, said the mayor, and replaced by a city map drawn up by the best planning experts in the country, with rules for amendment made so stringent as to discourage any change. Only then, concluded the mayor, can the city safely invest millions in schools, sewage plants, transit, housing and other capital facilities, without fear that changes in the living habits of the people will render the investment worthless.

Accident Causes First Death In St. Paul Sewer Tunnel Work

The first underground fatality in the construction of the extensive sewer program of St. Paul and Minneapolis occurred Feb. 8 with a rock fall from the roof near the shaft bottom on one of the five projects under way. The circular shaft, 100 ft. deep, had been completed and a short section of heading (about 14 ft. diameter) had been turned through hard sand rock. Driving was stopped while the roof was timbered as a matter of precaution, though no signs of weakness had been evident in the rock formation. Timbering of five-segment arches was being installed from the face back towards the shaft. The portal had been enlarged to provide more room, and workmen on scaffolding were erecting special bents at the enlarged section when about 6 cu. yd. of rock fell from the roof, carrying the scaffold with it. A workman passing under the scaffold at the moment was killed; two others were injured. The tunnel is part of the sewer program being carried out by the Minneapolis-St. Paul Sanitary District under the direction of C. C. Wilbur, chief engineer. Al Johnson, of Minneapolis, is contractor on this section.

First Railroad Trestle Completed Across Bonnet Carre Spillway

The first of the four railroad and highway structures being built across the Bonnet Carre spillway above New Orleans was completed Feb. 1 when operation of regular trains on the Yazoo and Mississippi Valley Railroad started across this span. The structure is about 8000 ft. long and is a single track ballast-deck type trestle on creosoted timber piles.

The Illinois Central Railroad trestle, of double track construction, will be completed by May with work progressing on schedule. The Louisiana Highway Commission's concrete highway structure will be completed in the early spring and the Louisiana and Arkansas railroad span is also scheduled to be finished before summer. The design and construction of these four long trestles were described in detail in *Engineering News-Record*, Jan. 3, 1935, p. 12.

Low-Cost Housing Problem is Discussed At Canadian Construction Meeting

A RECORD attendance of more than 500, an address by the Prime Minister of Canada, Rt. Hon. R. B. Bennett, and discussion concentrated on low-cost housing featured the seventeenth annual convention of the Canadian Construction Association, held in Montreal Jan. 22-24. Hamilton was selected for the convention of 1936. Wm. H. Yates, Jr., Hamilton, was re-elected president and F. G. Rutley, Montreal, vice-president. One of the resolutions passed called on the federal government to institute, as a regular practice, the public opening of bids in connection with government contracts.

The Prime Minister referred to the $40,000,000 program of public works initiated last year and stated that he had not been disappointed with the results so far obtained, adding, significantly, that it is the purpose of the government to continue in the course started last year, his hope being that this would increase employment in the construction industries.

Hon. C. J. Arcand, Minister of Labor for the Province of Quebec, stated that he was in favor of legislation in the province covering the licensing of contractors, a move which he could clearly foresee. An open discussion on the relations of government to industry occupied one afternoon session, three papers being presented by members from Vancouver, Winnipeg, and Montreal, special attention being given to recent labor regulations in the Province of Quebec, especially the recently enacted Collective Bargaining Act.

Low-cost housing

Attention was focussed on low-cost housing by an outstanding illustrated address by J. M. Pigott, Hamilton, on "Slum Clearance and Replacement." Mr. Pigott analyzed Canada's needs in this respect, paying special attention to the recently published report dealing with housing conditions in Toronto (a similar report is in process of preparation for Montreal), going on to describe what he considered to be the new technique which must be applied to such construction. He illustrated his points by examples from European practice, advocating, in conclusion, that all such work must be privately financed and constructed.

Dr. Ernest Kahn, well known German housing expert, and other leading housing authorities took part in the ensuing discussion. At the concluding luncheon, E. J. Bohn, Cleveland, President of the National Association of Housing Officials, discussed "Assisted Housing Policies," and after explaining the financial economy of such schemes, apart from their social economy, explained that in his view government financial assistance for such work was an essential. He gave a full description of recent action with regard to government housing policies in the United States.

Purdue to Offer Curriculum in "Public Service Engineering"

A new curriculum in "Public Service Engineering" will be inaugurated next September at Purdue University, according to an announcement by President E. C. Elliott, as a result of a realization that the functioning of government is becoming more technological in character. The new curriculum has a major objective in the preparation of engineers for positions in governmental service, capable of dealing with technologic problems.

The public service engineering curriculum will provide basic instruction in the elements of engineering with requirements in science, mathematics, and languages corresponding to the standard professional engineering curricula. In addition, considerable attention will be devoted in the course to government and social science subjects.

"The University expects," states Dean A. A. Potter, of the school of engineering, "that a considerable portion of the graduates of this curriculum will enter government service as a life work, thus carrying out one of the principal functions of education in relation to the government of a free people. It is also expected that this curriculum, which is more general than the standard courses of study in engineering, will appeal to those who are planning to enter business or non-technical pursuits and who wish to gain an appreciation of the technological devices and processes which influence their environment as well as of government which affects their freedom of action."

SOCIETY CALENDAR

AMERICAN CONCRETE INSTITUTE, annual meeting, New York City, Feb. 19-21.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, annual meeting, Chicago, March 12-14.

AMERICAN WATER WORKS ASSOCIATION, annual convention, Cincinnati, Ohio, May 6-10.

AMERICAN SOCIETY FOR TESTING MATERIALS, regional meeting, Philadelphia, Mar. 6; annual meeting, Detroit, June 24-28.

CONNECTICUT SOCIETY OF CIVIL ENGINEERS, annual meeting, New Haven, Feb. 19-20.

INDIANA ENGINEERING SOCIETY, meeting jointly with other technical societies at Indianapolis, Feb. 19.

KANSAS WATER AND SEWAGE WORKS ASSOCIATION, University of Kansas, Lawrence, Kan., Feb. 20-22.

ENGINEERING SOCIETY OF WISCONSIN, annual convention, Feb. 21-22, Madison.

MINNESOTA SURVEYORS AND ENGINEERS SOCIETY, annual convention, St. Paul, Feb. 21-22.

MINNESOTA FEDERATION OF ARCHITECTURAL AND ENGINEERING SOCIETIES, St. Paul, Minn., Feb. 22-23.

SOUTHWEST ROAD SHOW AND SCHOOL, eighth annual meeting, Wichita, Kan., March 5-8.

INDIANA SECTION, American Water Works Association, Indianapolis, March 7-8.

NEW YORK SECTION, American Water Works Association, spring meeting, Albany, March 21-22.

FLORIDA SECTION, American Water Works Association, West Palm Beach, March 27-30.

CANADIAN SECTION, American Water Works Association, London, Ont., March 27-29.

GREATER NEW YORK SAFETY CONFERENCE, sixth annual meeting, March 5-7.

Iowa Engineers Discuss Joining National Association

(Continued from p. 262)

and amendments in the existing registration law. One of the main points is in the list of exemptions. City employees are now exempt. The revised law would make it mandatory on city officials to hire only registered engineers. The Iowa League of Municipalities is strenuously opposed to this requirement. By persuasion and argument one city finally had designs for a sewage treatment plant and system reviewed by a registered engineer, when it was pointed out that the proposed special assessment proceedings might be successfully attacked and invalidated.

County surveyors' duties are handled in Iowa largely by county engineers. Legislation to define land survey methods and other surveyors' duties is to be revised to cover existing personnel and county engineers.

Some 27 technical papers were presented, primarily at the sessions of the four technical sections which held meetings in three rooms simultaneously.

Officers elected for the ensuing year are as follows: President, George Keller, vice-presidents, Quincy C. Ayres and R. E. Robertson, secretary-treasurer, John S. Dodds, Ames.

Personals

H. T. FLASHER has been promoted to the position of assistant chief engineer, Bureau of Maintenance, Ohio State Highway Department.

W. B. DAVEY, formerly assistant chief engineer of the Orleans Levee Board, has been named chief engineer to succeed John Klorer who recently resigned to take the position of Louisiana state engineer.

L. H. HUNTLEY, superintendent of construction on the Wheeler Dam project of the TVA, has been transferred to the Pickwick Landing Dam project of the TVA in a similar capacity.

R. E. HUTCHINS has joined the staff of the TVA in the general engineering division, engineering data section, with headquarters at Knoxville. He is on leave of absence from his position as associate professor of civil engineering at Rose Polytechnic Institute.

C. O. SHERRILL, former city manager of Cincinnati, has been appointed by Governor Davey of Ohio to head a special group selected to make a survey of the state government with a view to making recommendations for reorganization and economies. Before taking the city manager position in 1926 Colonel Sherrill had served in the Corps of Engineers since his graduation from West Point in 1901.

COL. JAMES A. WOODRUFF, division engineer of the North Atlantic division, U. S. Engineers, has been promoted to Brigadier General and assigned to command the Port of Embarkation, Fort Mason, San Francisco, Calif. Before coming to the New York post as division engineer on July 19, 1934, General Woodruff was district engineer at Philadelphia. During the

war he had an important part in developing the Army Forestry Service and was deputy director of construction and forestry in the American Expeditionary Forces.

Obituary

SAMUEL P. GUILFORD, long a member of the board of water commissioners of South Lynnfield, Mass., died at his home Feb. 5 at the age of 72.

HENRY A. PHIPPS, sewer commissioner of Dedham, Mass., for twenty years, until his retirement in 1934, died at his home on Feb. 7, at the age of 87.

CHARLES WALBORN, age 43, for nine years superintendent of maintenance for the Ohio highway department in Champaign County, died at Urbana, Ohio, recently from a stroke of paralysis.

SAM J. KUYKENDALL, age 38, died at his home in Little Rock, Ark., Jan. 29. He was a civil engineer and for twelve years was president and manager of the Dixie Culvert and Manufacturing Co. of Little Rock.

JOHN H. GRIFFIN, city engineer of Gloucester, Mass., died recently in Florida, while on leave of absence. He was a native of Gloucester and had been head of his department for about ten years, also serving as superintendent of highways during the past four years.

JAMES MONAHAN, superintendent of streets in the public works department of Everett, Mass., for nearly seventeen years, died suddenly in that city on Jan. 28. He was born in Everett 59 years ago, and after a short period in contracting work, entered the city's employ in 1900.

GEORGE O. VON NERTA, for many years prominent in federal building activities, died in Washington Jan. 28 at the age of 90. Born in Germany, he received his engineering education at the Imperial Military Academy in Berlin and served for some time as an officer in the German army. On his second visit to the United States he established himself in the engineering and architectural profession and took an active part in the direction of work on the government building program, particularly the Federal Triangle. He had been permanently exempted from retirement by order of the President and at the time of his death held the post of supervising engineer, public works branch, procurement division of the Treasury Department.

CONSTRUCTION STATISTICS OF THE WEEK

HIGH PRIVATE AWARDS, for the fourth consecutive week, bring this week's volume of engineering construction up to $17,194,000. This total is for a 4-day week compared with $17,237,000 for a 5-day period last week. Of this total $8,311,000 is private construction and $8,883,000 public work—the lowest volume of public awards since 1932. Of the public $2,952,000 represents federal awards and $5,931,000 state and municipal.

Public building awards at $3,437,000, are higher than last week, and "unclassified" awards including railroad work are up to $4,947,000. Bridges are higher at $3,747,000 due to large private contracts. Other classes of work are low, with street and road awards down to $2,887,000.

The larger lettings for the week include: housing development for Georgia Relief Administration in Pine Valley Settlement, Harris Co., Hamilton, Ga., federal aircraft factory including engine manufacturing shop, test building, etc.; Bureau of Yards and Docks, Philadelphia, Pa., $893,000; highway awards by Illinois, $507,000; three contracts for grade elimination work by N. Y. Central R.R., in New York, $3,210,000; Contracts 1 and 7, Coney Island sewage treatment works including wharf and filling site, Sanitation Dept., Brooklyn, N. Y., $516,000; levee work in Louisiana by U. S. Corps of Engineers, $679,000; rails, Chicago, Burlington & Quincy R.R., Chicago, Ill., $530,000; rails and track work by day labor on 75 miles of line by St. Louis-San Francisco Ry., St. Louis, $3,700,000.

Continued heavy rescissions and reductions of PWA allotments which are not offset by equivalent reallotments hold the new capital curve down. This week the excess of withdrawals of PWA financing over allotments is $7,018,000 for non-federal work. Net new allotments for federal work totaled $150,000. State and municipal bond sales were higher, totaling for the week $6,388,000.

CONTRACTS

(Thousands of Dollars)

	Weekly Average Feb. 1934	Prev. 4 Weeks	Week Feb. 14 1935
Federal Government	$10,091	$4,554	$2,952
State and municipal	12,311	12,775	5,931
Total public	$22,402	$17,329	$8,883
Total private	3,663	5,538	8,311
Week's total	$26,065	$22,867	$17,194
Cumulative to date: 1934...$220,409,000		1935...$182,695,000	

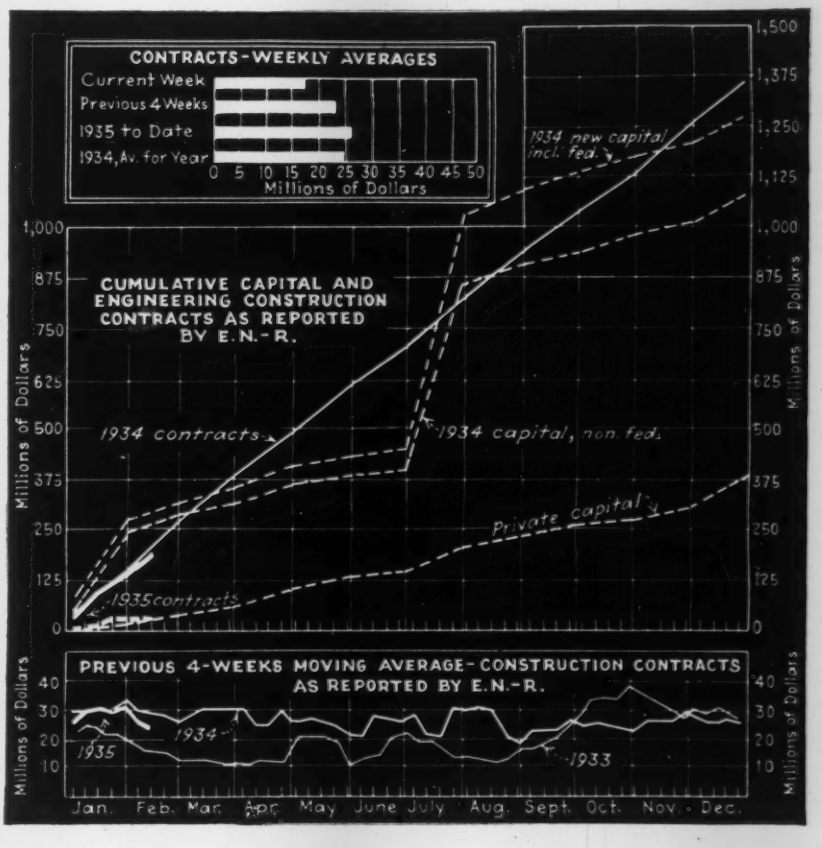
NEW PRODUCTIVE CAPITAL

(Thousands of Dollars)

1935	Week Feb. 14	Cumulative
State and municipal	$6,388	$49,789
PWA allotments, S&M	—7,018	—29,608
RFC loans, S&M	.....	63
Corporate issues	.....	.....
PWA allotments, private	.....	3,946
Total, Non-Federal	—$630	$24,190
PWA allotments, Federal Constr.	150	6,505
Total new capital	—$480	$30,695
Cumulative to date: 1934...$304,076,000		1935...$30,695,000

INDEX NUMBER

E.N.-R.- Cost	1913 = 100	1926 = 100	E.N.-R.- Volume	1913 = 100	1926 = 100
Feb., 1935	196.02	94.22	Jan., 1935	130	57
Jan., 1934	198.72	95.52	Dec., 1934	105	46
Feb., 1934	194.05	93.20	Jan., 1934	149	65
1934 (Av.)	198.10	95.23	1934 (Av.)	114	50
1933 (Av.)	170.18	81.80	1933 (Av.)	102	47
1932 (Av.)	156.97	75.45	1932 (Av.)	127	56



Current Construction Unit Prices

Twin Cities Sewers, Contract 105

ANOTHER link in the extensive PWA sewer program of St. Paul and Minneapolis was placed under contract late in September, 1934, with the award of Contract 105 for the construction of an intercepting sewer and shaft in St. Paul. Alternates were taken for both tunnel and shaft, the former on an elliptical section 11 ft. 9 in. in diameter and a circular section 11 ft. 9½ in. in diameter (award on latter basis) and for a circular shaft 11½ ft. in diameter or a rectangular shaft 8x12 ft. (awarded circular). The sewer starts near the corner of College Ave. and Wabasha St., and extends northwesterly for 5,300 ft. Driving will be entirely through sand rock. C. C. Wilbur is chief engineer of the Twin Cities sanitary district. Five bids ranged from $505,783 to $539,965 for the circular tunnel and shaft. The following tabulation gives unit prices of the three low bidders. Minor items are not shown.

TOTAL BIDS, MINNEAPOLIS-SAINT PAUL SANITARY DISTRICT TUNNEL

	On circular sections	On elliptical tunnel, circular shaft
A—Frazier-Davis Const. Co., St. Louis, Mo. (contract)	$505,783.00	
B—Geo. R. Cook Co., Detroit, Mich.	513,590.00	$566,590.00
C—New Mexico Const. Co., Albuquerque, N. M.	514,266.50	604,366.50

MINNEAPOLIS-SAINT PAUL SANITARY DISTRICT TUNNEL, CONTRACT 105

Item	Quantity	Unit Bids A	B	C
1.	11 ft. 9 in. elliptical tunnel section—5,300 lin.ft.	.....	$95.00	$100.00
1(a).	11 ft. 9½ in. circular tunnel section—5,300 lin.ft.	$82.50	85.00	83.00
2.	8 ft. x 12 ft. rect. shaft (lump sum)	.....	.....	70,000.00
2(a).	11½ ft. circular shaft (lump sum)	30,000.00	30,000.00	57,000.00
3.	18-in. pipe subdrain—5,300 lin.ft.	6.50	4.00	2.00
4.	Misc. cast iron & steel—3,000 lb.	.10	.15	.15
5.	Concrete cores—53 each	20.00	30.00	20.00
6.	Engineer's field office (lump sum)	1,000.00	7,950.00	2,500.00
7.	Clean up (lump sum)	1,000.00	7,950.00	2,500.00

White River Levees, Arkansas

TWO CONTRACTS were awarded Dec. 7 and 27, 1934, by the U. S. Engineer Office, Memphis, for the construction of levees in the White River district of Arkansas. The first contract, awarded to the Driver Co., Memphis, covers 2,273,000 cu.yd. under four contract items. Proposals were received from 23 firms in all for the four items in various combinations, with unit bids ranging from 14.2c. to 26c. per yard. The second contract of 1,000,000 cu.yd. went to the Louisiana Materials Corp., New Orleans, whose low combination unit of 14.6c. for the two items included, is compared with a high of 25c. from the fifteen proposals submitted. Tabulation of the bids, unit and total, submitted by the three lowest bidders for each conract follows.

CONTRACTORS AND TOTAL BIDS, WHITE RIVER LEVEES

Contract No. 1:	
A—Driver Co., Memphis (contract)	$322,766
B—S. K. Jones Const. Co., Memphis	366,862
C—Clark Bros. Const. Co., Clinton, Ia.	367,330
Contract No. 2:	
D—Louisiana Materials Corp., New Orleans (contract)	146,000
E—Driver Co., Memphis	148,500
F—S. K. Jones Const. Co., Memphis	148,900

UNIT PRICES, WHITE RIVER LEVEES

Item and quantity	Contract No. 1 A	B	C
1. Embankment—645,000 cu. yd.	$0.142	$0.1614	$0.155
2. Embankment—552,000 cu. yd.	.142	.1614	.165
3. Embankment—506,000 cu. yd.	.142	.1614	.165
4. Embankment—600,000 cu. yd.	.142	.1614	.165
	Contract No. 2 D	E	F
1. Embankment—475,000 cu. yd.	$0.146	$0.1485	$0.1489
2. Embankment—525,000 cu. yd.	.146	.1485	.1489

Dam No. 16, Upper Mississippi River

ANOTHER link in the canalization of the Upper Mississippi River was placed under contract with the award, early in December, 1934, for the construction of Dam No. 16 near Muscatine, Iowa. This dam will be of the roller gate type, similar to others under way and contemplated on the Mississippi. Ten bids were submitted, ranging from $2,053,130 to $2,794,662, a remarkably small spread as compared with bids for previously awarded structures on the river. The project comes under the jurisdiction of Maj. R. A. Wheeler, U. S. District Engineer, Rock Island, Ill.

Following are unit prices of the three lowest bidders: (A) Central Engineering Co., Davenport, Ia., (contract) $2,053,130; (B) United Const. Co., Winona, Wis., $2,189,387; (C) McCarthy Improvement Co., Davenport, $2,246,835.

DAM NO. 16, MISSISSIPPI RIVER

		Unit Prices A	B	C
1.	Cofferdam—1,151 lin.ft.	$187.50	$217.82	$210.00
2.	Excavation, common—82,500 cu.yd.	.35	.328	.38
3.	Excavation, dredged—775,000 cu.yd.	.13	.154	.175
4.	Excavation, rock—200 cu.yd.	3.00	10.00	4.00
5.	Channeling, rock—800 sq.ft.	1.50	2.00	.83
6.	Drilled holes; grout first 10 ft.—601 l.f.	.75	2.00	1.50
7.	Drilled holes; grout second 10 ft.—301 l.f.	1.00	4.00	1.75
8.	Pressure grouting; cement—10 bbl.	10.00	15.00	5.00
9.	Fill—20,500 cu.yd.	.25	.1996	.18
10.	Embankment, dike—35,000 cu.yd.	.25	.1096	.12
11.	Piling, timber—170,000 l.f.	.545	.5058	.565
12.	Piling, timber batter—7,820 l.f.	.695	.6045	.80
13.	Piling, concrete—3,600 l.f.	2.30	2.43	2.75
14.	Piling, steel sheet—168,100 sq.ft.	1.30	1.295	1.23
15.	Pile load tests—5	500.00	382.07	218.00
16.	Timber, oak—19 M.f.b.m.	165.00	147.06	125.00
17.	Timber, y.p. creosoted—38 M.f.b.m.	158.00	129.54	121.00
18.	Stone, protection, derrick—13,920 cu.yd.	3.75	3.69	3.40
19	Stone, protection, riprap—11,400 cu.yd.	3.00	2.80	2.80
20.	Gravel road surfacing—430 cu.yd.	2.00	2.97	2.50
21.	Gravel embankment protection—1,900 cu.yd.	2.50	2.97	2.60
22.	Concrete, class A—1,060 cu.yd.	20.00	24.95	20.70
23.	Concrete, class B—59,000 cu.yd.	9.88	10.69	10.68
24.	Structural steel, service bridge—1,375,000 lb.	.06	.0535	.072
25.	Structural steel, tainter gate—1,330,000 lb.	.055	.0637	.068
26.	Structural steel, roller gate—1,005,000 lb.	.065	.0952	.083
27.	Structural steel, misc.—1,135,000 lb.	.063	.062	.074
28.	Steel, reinforcing—2,560,000 lb.	.04	.0403	.04
29.	Steel, corrosion resisting—26,500 lb.	.60	.5966	.60
30.	Steel forgings, carbon—126,000 lb.	.10	.1121	.10
31.	Steel forgings, alloy—50,300 lb.	.14	.1579	.16
32.	Steel castings, class B—236,000 lb.	.13	.1418	.145
33.	Iron castings—3,050 lb.	.09	.1166	.124
34.	Brass and bronze—8,780 lb.	.38	.512	.50
35.	Copper—1,500 lb.	.60	.4763	.50
36.	Misc. metals—35 lb.	.50	1.67	.50
37.	Metal shoes, wood piles—100	2.50	2.24	1.75
38.	W. I. pipe, extra heavy, ½-in.—401 l.f.	1.25	.695	1.40
38.	(a) W. I. pipe, std. 1-in.—321 l.f.	1.50	1.19	1.50
39.	Culvert pipe, corr. iron 12-in.—141 l.f.	1.00	1.19	1.25
40.	Fence—2,730 lin.ft.	.15	.22	.18
41.	Conduit, 3-in. fibre—7800 l.f.	.35	.2917	.45
42.	Conduit, ½-in. rigid metal—351 l.f.	.50	.1786	.53
43.	Conduit, 1-in. rigid metal—1,100 l.f.	.50	.5239	.44
44.	Conduit, 1¼-in. rigid metal—1,825 l.f.	.75	.6906	.75
45.	Conduit, 2-in. rigid metal—330 l.f.	.90	.9883	1.00
46.	Conduit, 2½-in. rigid metal—175 l.f.	1.25	1.49	1.75
47.	Conduit, 3-in. rigid metal—260 l.f.	1.50	1.67	2.00
48.	Electrical grounding system (lump sum)	300.00	297.69	375.00
49.	Crane track, 80-lb. rail.—1,300 track ft.	3.00	4.227	3.55
50.	Hand rail, steel pipe—1,615 l.f.	1.50	2.38	2.40
51.	Hand rail, steel pipe complete—310 l.f.	.65	1.19	1.25
52.	Steel floor grating, weld or rivet—940 sq.ft.	.90	.9526	1.00
53.	Rubber seals, moulded 6,200 lb.	.85	.7144	.82
54.	Operating machinery for gates—4 each.	13,000.00	14,036.61	15,000.00
55.	Roller gate mach. spare parts—1 lot	4,500.00	5,838.50	7,000.00
56.	Roller gate operating house complete—5 each	4,500.00	3,000.00	5,600.00
57.	Operating mach. tainter gate—15 each.	5,200.00	5,600.00	6,000.00
58.	Tainter gates, spare parts—1 lot	600.00	726.36	1,000.00
59.	Tainter gate machinery spare parts—1 lot	4,500.00	5,429.87	5,100.00
60.	Tainter gate heaters complete—9 (per gate)	244.00	300.07	300.00
61.	Roller gate heaters complete—4 (per gate)	2,000.00	1,964.75	2,360.00
62.	Install locomotive crane	1,000.00	1,190.76	1,500.00
63.	Flat car—1 each	875.00	1,369.38	1,250.00

BUSINESS SIDE OF CONSTRUCTION

January Construction Volume Higher Private and Non-Federal Awards Up

JANUARY engineering construction awards total $148,264,000 for a five-week month compared with $132,581,000 a year ago on a four-week month. These totals include $22,000,000 for day labor and materials on Pickwick Dam for 1935 and $32,000,000 for day labor and materials on Norris Dam. Both state and municipal and private awards are higher for the first five weeks of 1935 than for the corresponding total in 1934, the former by 15 per cent and the latter by 20 per cent. The 1935 totals are private awards, $23,479,000, and public, $124,785,000 of which $48,736,000 is federal and $76,049,000 state and municipal. The volume index for January is 130 based on 1913 equals 100. This higher volume index is aided by a slight drop in the cost index.

Based on weekly averages highway awards dropped 32 per cent behind the rate of awards for the corresponding period in 1934. Public and industrial building classifications both were more active than in January, 1934, while commercial buildings continued low.

New England, Middle West and Far West start out with higher rates of contract letting than in 1935 while Middle Atlantic, West of Mississippi and South show a lower rate of activity. South's high volume in January and March, 1934, was due largely to large Federal projects, notably the Tennessee Valley Authority dams.

New Capital

The municipal bond market continued strong and in January bought $34,219,000 worth of new construction bonds. This total includes $2,653,000 which represents a transfer from federal to private financing rather than new financing since it is the January sale of PWA bonds by the RFC. Offsetting this active bond market is a net reduction of $9,152,000 in PWA allotments outstanding due to rescissions, bond sales, and changes from loan and grant allotments to grant only. Including corporate loans by PWA the total "new capital" for non-federal construction is $28,719,000 for January and $31,250,000 including Federal allotments.

Materials

Cement—Cement shipments in December totalled 3,104,000 bbl., a decrease of 17 per cent compared with December, 1933, as reported by the U. S. Bureau of Mines. Production, however, showed an increase of 26.1 per cent and stocks at mills were 9.6 per cent higher than a year ago. The ratio of production to capacity was 19.5 per cent in December compared with 15.5 per cent the previous year and 26.2 per cent the previous month.

Steel—The operating rate of steel companies having 98.7 per cent of the steel capacity of the industry as reported by the

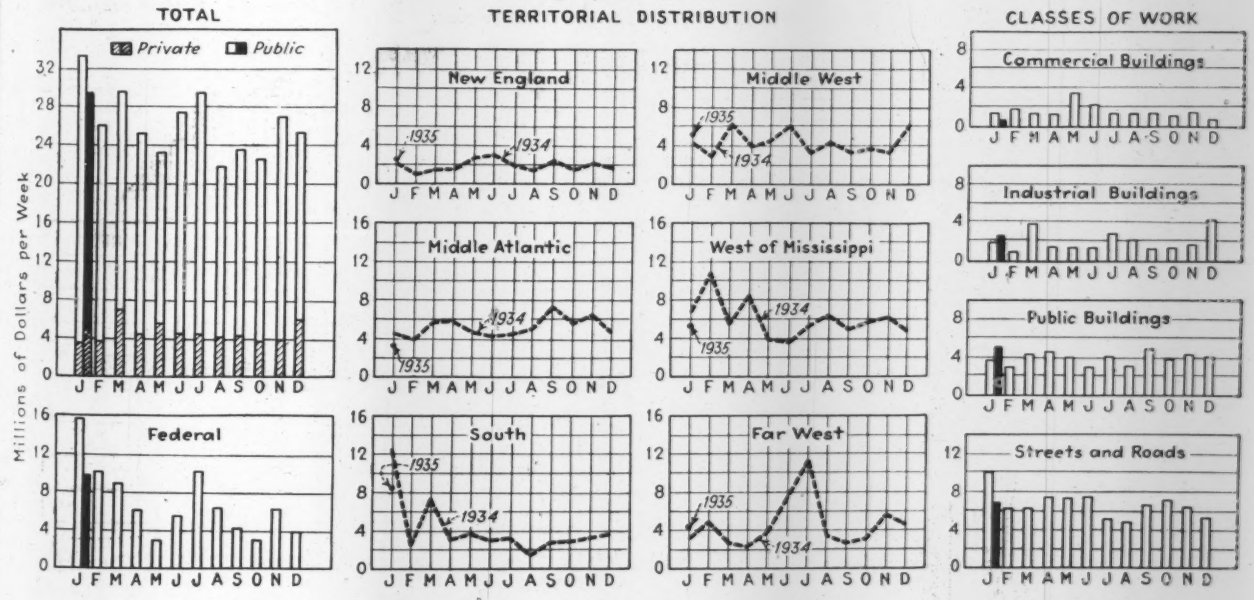
ENGINEERING CONSTRUCTION CONTRACTS REPORTED IN JANUARY, 1935

Five Weeks—Thousand of Dollars (000 Omitted)

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States Jan., 1935	United States Jan., 1934	Canada
Public Works									
Waterworks	247	593	177	2,117	2,551	3,981	9,666	1,769	105
Sewerage	293	1,871	336	838	1,847	297	5,482	2,463	...
Bridges, public	364	890	669	1,204	2,977	1,688	7,792	8,830	35
Earthwork and waterways	42	46	25,828	4,549	5,645	3,282	39,392	49,491	333
Streets and roads	1,444	5,011	6,039	9,812	9,399	2,690	34,395	39,611	424
Buildings, public	5,961	5,023	4,569	1,685	3,619	4,755	25,612	14,843	2,122
Unclassified, public	297	846	348	228	184	543	2,446	2,406	802
Total public	8,648	14,280	37,966	20,433	26,222	17,236	124,785	119,413	3,821
Federal gov't. (included in above classifications)	3,749	1,425	29,035	5,294	5,331	3,902	48,736	30,127	...
Private									
Bridges, private	...	146	...	30	...	...	176	582	...
Buildings, industrial	380	969	867	4,399	673	4,126	11,414	7,358	60
Buildings, commercial	250	2,356	28	366	650	110	3,760	4,983	150
Unclassified, private	3,028	50	3,775	1,138	50	88	8,129	1,245	...
Total private	3,658	3,521	4,670	5,933	1,373	4,324	23,479	14,168	210
January, 1935 (5 weeks)	**12,306**	**17,801**	**42,636**	**26,366**	**27,595**	**21,560**	**148,264**	.....	**4,031**
December, 1934 (4 weeks)	6,500	18,818	14,624	24,040	19,083	18,354	.....	101,419	4,696
January, 1934 (4 weeks)	8,607	18,182	49,793	17,562	27,055	12,382	.....	133,581	1,156

ENGINEERING CONSTRUCTION REPORTED BY E.N.-R.—WEEKLY AVERAGES

□---1934 ■—1935



American Iron and Steel Institute averaged 46.4 per cent for January after climbing steadily from 39.2 per cent the first week to 52.5 per cent the last week. This average for the month compares with an average of 34.1 per cent a month ago and 32.2 per cent a year ago. The average for January represents a rise of 12.3 points or 36 per cent over December and of 14.2 points or 44 per cent over January 1934. Shipments of fabricated structural steel in December were 32 per cent larger in volume, while the bookings during the month recorded a decline of 36 per cent from the same month last year. This estimate is based upon reports received by the American Institute of Steel Construction from 81 per cent of the industry. The shipments were in a volume comparable to the average monthly shipments the first half of the year, whereas the bookings were 25 per cent less.

Lumber—For 1934 as a whole, lumber production according to preliminary reports of the National Lumber Manufacturers Assn., was 4.5 per cent above that of 1933 at mills reporting and is estimated to be about 10 per cent over 1933 for all mills. The estimated total production for the year is 15,500,000,000 feet compared with 14,000,000,000 feet in 1933 and 10,000,000,000 feet in 1932, the lowest in 65 years.

The first week of 1935 brought increases in new business, shipments and production of lumber over preceding weeks and a large increase over the same period in the preceding year. The second week brought the heaviest lumber shipments except for one week since May, 1934, with increases also in shipments and production. The third week just about held this volume but the fourth week, due partly to severe weather, saw declines. However, the average for the month represents a gain in lumber movement.

Prices

As a whole January prices (reported last week) were fairly steady. Lumber prices continued spotty with decreases at Atlanta, Cleveland, New York (on Douglas Fir), St. Louis and Seattle and increases in Boston. Cement dropped 15c. at Michigan mills and 10c. at Detroit delivered. Labor is reported higher at Dallas and lower at Seattle. The common labor wage situation in New York is unsettled.

Labor

Employment in the production of six Major Construction Materials is reported by the Federal Employment Stabilization Office for December at 39.8. This represents an increase over December, 1933, at 38.8 but a decline from November, 1934, at 41.0. The base for this index is 1923-1925 = 100.

Industrial fatalities in 1934 in New York State charged to construction were 162 compared with 198 in 1933; 341 in 1932; 462 in 1931 and 529 in 1930 a decline of 69 per cent between 1930 and 1934. Heavy engineering construction declined 81 per cent in this same period, however.

Employment as reported by 1,099 contractors working in New York State in November dropped 4.6 per cent as compared with October. Payrolls dropped 0.6 per cent and hours 5.9 per cent. Employment by highway contractors dropped 19.8 per cent, by miscellaneous general contractors, 6.4 per cent, and by subcontractors 2.5 per cent. General building contractors employed about 11 per cent more workers this month than last.

Better conditions for construction employees were evident in New York City in November as increases were reported in employment, payrolls and hours for all kinds of construction.

Employment in building construction as reported by the U. S. Bureau of Labor Statistics was up 3.4 per cent in October but declined 2.3 per cent in November with payrolls up 5.9 per cent and down 3.0 per cent in respective months. These data are based on reports from 10,810 firms in October and 10,772 firms in November who are engaged in public and private building construction not financed or aided by PWA funds.

In October, nearly 510,000 employees and in November 470,000 workers were employed at the site on Public Works Administration Construction projects.

In October employment on federal works was distributed as follows: building construction, 27,105; public roads, 192,498; river, harbor, and flood control, 57,034; streets and roads (other than those reported by Bureau of Public Roads), 14,256; Naval vessels, 19,274; reclamation, 18,018; forestry, 4,528; water and sewerage, 1,218; miscellaneous, 15,129, or a total of 349,060. On non-federal work financed by PWA, employment was distributed as follows: building construction, 44,815; streets and roads, 23,020; water and sewerage, 37,842; railroad construction, 24,787; miscellaneous, 1,237, making a total of 131,701 wage earners. These totals represent a decrease from September of 40,000 workers on federal work and an increase of 4,000 workers on non-federal work. The November total represents a decrease from October of 20,000 wage earners on federal work and a decrease of 10,000 on non-federal projects.

Labor controversies were not numerous during January. A one man strike held up concrete pouring on the Hampton Avenue viaduct in St. Louis when a hoisting engineer was called out by his union which objected to using gravel for concrete aggregate which came from a materials company which does not employ union labor at its operations.

At Columbus, Ohio, 7 crane operators on the new sewage disposal plant went on strike Jan. 3, for an increase from the current $1.10 rate to $1.40, with a minimum of 30 hours of work guaranteed each week. The strike was settled January 11 with a guarantee of a minimum of 15 hours of work every week.

Work was halted on the $7,000,000 alkali plant of the Solvay Process Co., near Baton Rouge on a demand for higher wage rates and longer hours. About 300 hoisting engineers, machinists and electricians but no carpenters or other workers were involved. The work, however, was tied up. The demand was reported to be for an increase from 75c. to $1.00 per hour and to 40 hours a week.

At East St. Louis, the laborers' union called its members who were earning 67½c. an hour off the Cahokia Creek diversion project on a demand of 95c. an hour. The contractor raised the rate to 75c. and began recruiting men from the Free Employment office.

At St. Louis, demands made by the International Union of Operating Engineers, Local No. 513, on members of the Associated Excavating, Grading and Wrecking Contractors of Missouri, Inc., to hire oilers at $8 a day on gasoline shovel machines on present and future excavating jobs will be ignored, it was announced following a meeting of the excavating contractors held on Feb. 5.

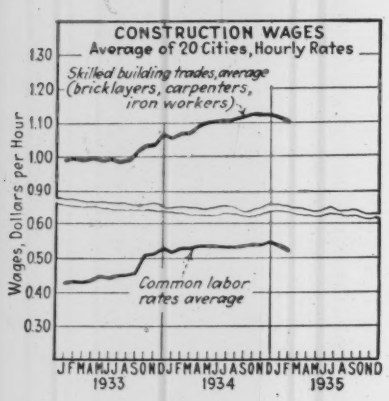
EN-R Cost and Volume Index

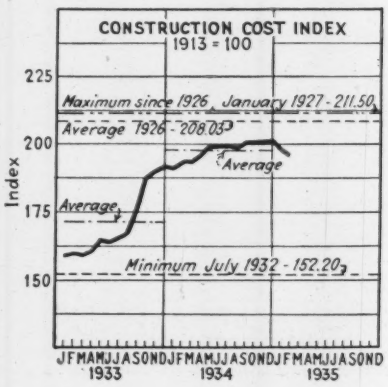
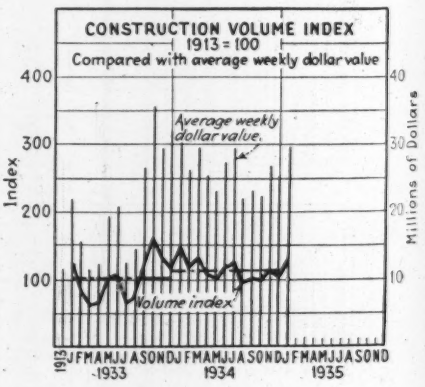
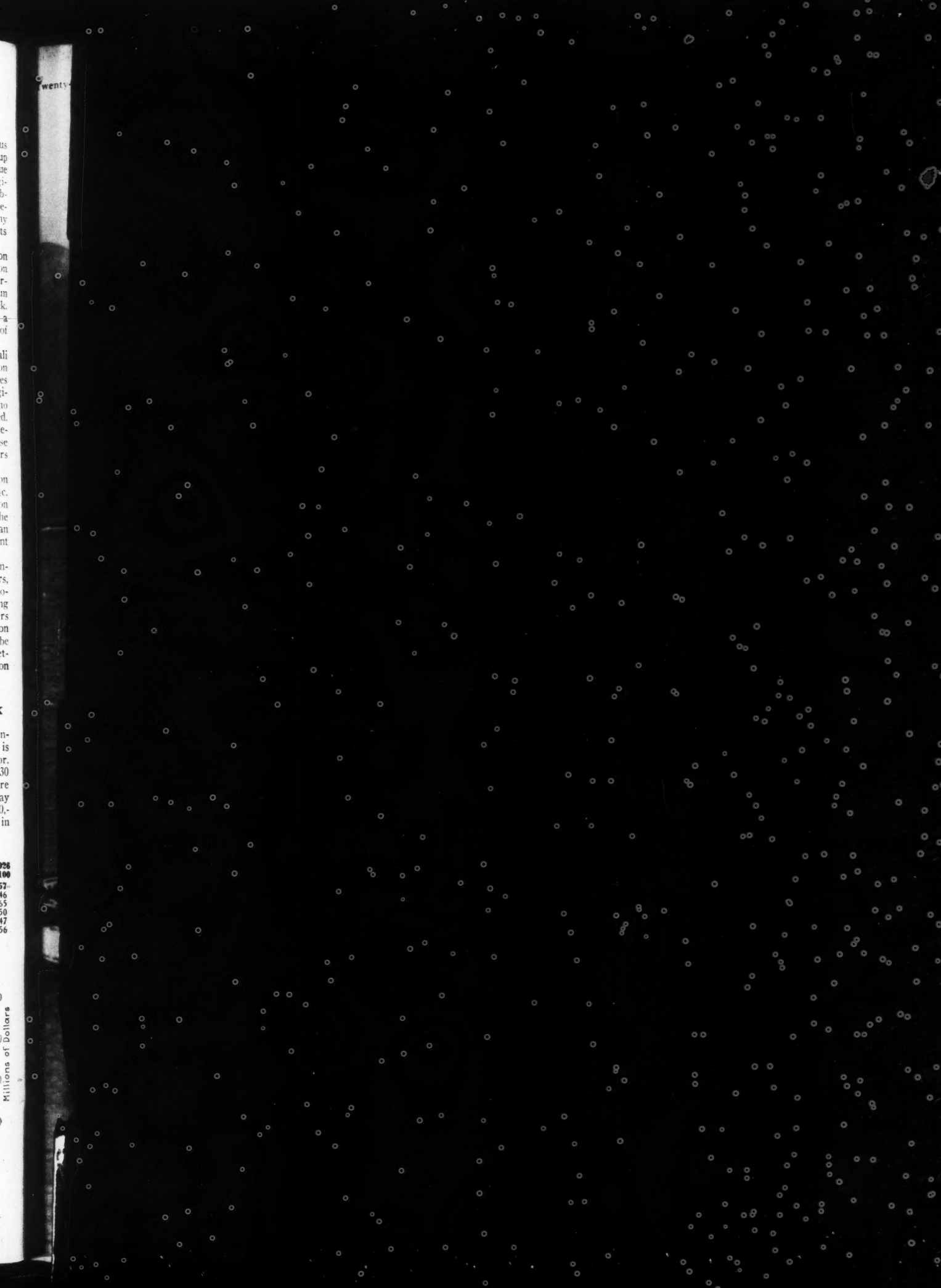
THE *Engineering News-Record* Construction Cost Index for February is 196.02 with the decline due wholly to labor.

The Volume Index for January is 130 compared with 149 a year ago. Both are influenced by abnormally high Federal day labor amounts, the Pickwick Dam $22,000,000 in 1935, and Norris Dam $32,000,000 in 1934.

INDEX NUMBER

E.N.-R.- Cost	1913 = 100	1926 = 100	E.N.-R.- Volume	1913 = 100	1926 = 100
Feb., 1935	**196.02**	**94.22**	**Jan., 1935**	**130**	**57**
Jan., 1934	198.72	95.52	Dec., 1934	105	46
Feb., 1934	194.06	93.20	Jan., 1934	149	65
1934 (Av.)	198.10	95.23	1934 (Av.)	114	50
1933 (Av.)	170.18	81.80	1933 (Av.)	102	47
1932 (Av.)	156.97	75.45	1932 (Av.)	127	56


CONSTRUCTION WAGES
Average of 20 Cities, Hourly Rates
Skilled building trades, average (bricklayers, carpenters, iron workers)
Common labor rates average
Wages, Dollars per Hour
1.30
1.20
1.10
1.00
0.90
0.60
0.50
0.40
0.30
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1933
1934
1935


CONSTRUCTION COST INDEX
1913 = 100
Maximum since 1926, January 1927 - 211.50
Average 1926 - 208.03
Average
Average
Minimum July 1932 - 152.20
Index
225
200
175
150
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1933
1934
1935